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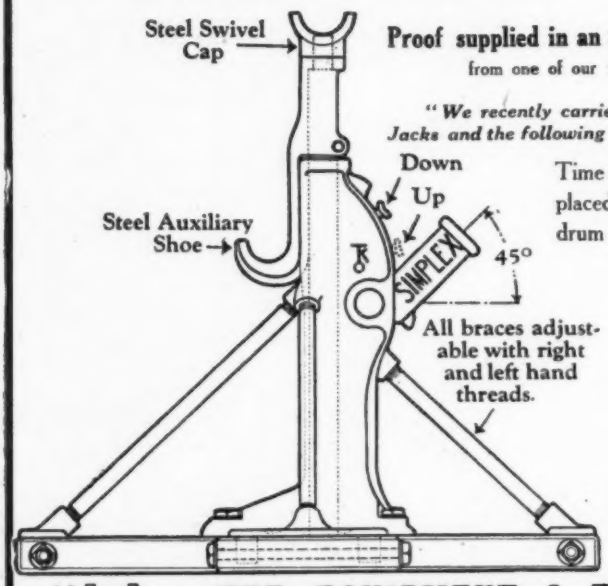

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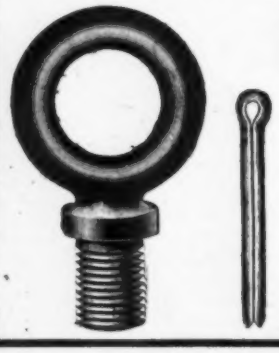

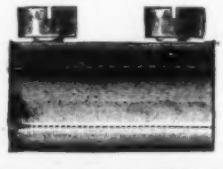

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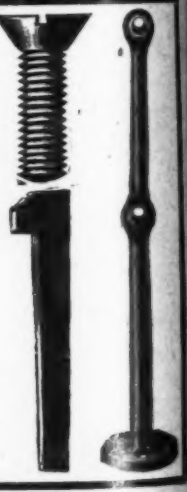

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The

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The Work of the Balfour Committee.

FROM our frequent references to the subject, our readers have learned that the committee appointed six months ago* by the late Government to report upon the conditions and prospects of British industry and commerce, with special reference to the export trade, has been taking evidence.

It is known as the Committee on Industry and Trade, and sits under the very competent leadership of Sir Arthur Balfour of Sheffield. Its task is so immense that only men and women of exceptional courage would dare to undertake it; already some of the members have found it impossible to continue; and other casualties will be sure to follow before the "recommendations" stage is reached. The Baldwin Government, when it came into power, gave its approval to the original terms of reference and all sorts of investigations have been proceeding.

In the first instance it devoted its main attention to the position of a number of our great producing and manufacturing industries and the trades associated with them, namely, coal, iron and steel, engineering and shipbuilding, electrical manufacturing, and so on. Government departments furnished a mass of material in statistical and other forms within a commendably brief period. No doubt the documents collated and the statistics summarised have included the data, evidence, and recommendations contained in those many reports that interested us all so much during the war and in "reconstruction" scheme days, when—*on paper*—we were building "a new world." The committee is taking evidence from representatives of industry, both through the accredited manufacturers' organisations

* See ELEC. REV., August 1st, 1925, p. 188, August 8th, pp. 202, 216.

and through the trade unions, but there is nothing to prevent anybody from giving independent evidence who can help to right conclusions, though with so much to do it is not to be supposed that time can be spared for anybody with a purely individual grievance. We are sure that Sir Arthur and his colleagues and secretaries will welcome evidence from anybody who has a legitimate claim to be heard.

The chairman made a statement on behalf of the committee the other day, in which he indicated to us some of the questions which are suggested by the terms of reference. We may quote them as showing how complete and thorough is the investigation that is taking place:—

How does the total volume of our trade in recent years compare with its volume pre-war, and how does it compare with the total world trade then and now? Have we lost, gained, or only retained our share? What is the volume of our trade with individual markets? In the case of markets which are physically undeveloped, or where for various reasons we have never done a large trade, what are the possibilities of development? In the case of those markets where our trade has a footing, are we doing more or less than we did under pre-war conditions? If our trade with any country has diminished, is this due to that country buying more largely from other sources, or making the goods for itself, or going without them? If it is buying from other sources, what are the reasons which enable goods from those sources to outsell ours? In particular, what are the facts as to costs of production and prices in the United Kingdom, methods of marketing, and other factors affecting the success of our foreign trade, and, therefore, the prosperity of the industrial population? In other words what are the prospects of our being able to secure sufficient and continuous employment and a satisfactory standard of living in this country?

From our own recent articles it can be imagined that the one question of cost of production might form by itself a subject for lengthy inquiry, but the committee is hoping to obtain data showing the reasons for the increases in costs which have occurred, and to investigate the various factors involved, *e.g.*, the cost of materials, the wages bill, the cost of fuel or power, and transport, the burden of rates and other charges, the efficiency of labour and management, the supply and remuneration of capital, &c. This is a difficult inquiry even as regards the United Kingdom; and it would no doubt be much more difficult to obtain corresponding particulars relating to the foreign countries which are our principal competitors.

An effort to this end will be made, however, in view of the frequent assertion that, as regards wages and other factors, conditions abroad are more favourable for manufacturing than in the United Kingdom. The question of the competitive power of foreign manufacturers naturally relates itself not only to the subject of competition with British goods in foreign markets, but also to the problem of the competition of foreign imports in this country; on this matter considerable evidence will be heard.

The committee is proceeding with some of its investigations through sub-committees, but all evidence is being and will be heard by the full committee, and as has been stated in these pages already, the material and opinions gathered together will not be filed away for ultimate burial in a many-volumed report. Returns soon become out of date and opinions lose their point. There may be interim reports where such are found desirable, and a number of volumes containing statistical and other data of assistance in connection with export trade will be issued during 1925. We have need of all the immediate assistance that can be given to export trade expansion while the committee is sitting; we cannot afford to wait for the publication years hence of its elaborate report and recommendations. Therefore a service is to be rendered by the publication of a survey of all the important countries of the world in their aspect as markets where British goods have found or may find an entry. British industry has been urged again and again to endeavour to find new markets for its products, and it will welcome records that will help it to do so. But it knows only too well that the output capability of all producing peoples has been greatly increased during the past decade, whereas the world's purchasing power is still far from what it was. It looks beyond a little space to the time when by the development of the immense untapped resources of the world new demands will arise for manufactured goods. There is need for us to promote new demand in the vast undeveloped lands; it is not sufficient—though we are far from underestimating its importance—to become more efficient in securing the already available business in competition with producers of other nationalities. No study of the future prospects of British export trade can be complete without this aspect of the subject receiving attention.

Sir Arthur Balfour does not underestimate the size of his task. May he have health and energy to pursue it to the end! We have had many trade committees in the past and mutitudinous reports and a veritable mass of recommendations, but such an investigation as the present one has never been made by any committee. It is his determination to produce such a study as will form a record complete and faithful up to the current year, co-ordinating all previously-prepared data that are of value, so that if a new study be required in five or ten years' time this present record will furnish a starting point and simplify the inquiry.

Possibly, "in due course," to adopt a safely vague expression, the committee will be able to advance united recommendations which shall form the basis for legislative action during the life of the present Government, but it is obvious that in their deliberations the members are taking the long view. That is most necessary for the ultimate good of the race, but it will not feed hungry men *now*. Mr. Samuel, Parliamentary Secretary of the Department of Overseas Trade, says that the clouds are breaking, and that there are signs of returning prosperity. Let us launch out into the deep in these times of greater confidence. We cannot afford to wait for the recommendations of the best of committees. The return of hope throughout the world is reviving purchasing power. Financial and engineering enterprise will assist the development of the world resources, renewing and increasing demand; but the clamant call of our unemployed is to go out and secure more of the already available business. We are constantly being told that we have little to fear yet awhile from the competition of certain countries; but not once or twice, but many times of late, have we received reports from Colonial and foreign markets of the feverish activity of the commercial travellers of those self-same countries and the low prices at which they are offering goods.

C. H. Wordingham.

THE age of electricity is no longer "in its infancy"; one by one the pioneers are passing from us into rest. Those of us who have spent our working lives in the industry and can recall the quaint practices of the 'eighties are best able to realise the immense strides that have been made in electrotechnology since then, thanks to the splendid efforts of our leaders. Many of these, happily, are still with us—long may they continue to rejoice in their achievements and to assist us with their counsel—but others whose physical powers have proved unequal to the strain imposed upon them by their unresting mental activities have joined the silent legions. Few have made a deeper impression on their time or left more kindly memories than our old friend, Mr. C. H. Wordingham, whose career has ended all too soon, when it was reasonable to look forward to many more years of public service. On a following page we give a brief account of his strenuous life and of the visible monuments that have grown out of his labours; but the most worthy memorial of Wordingham is that

which is enshrined in the hearts of his friends—the memory of a Christian gentleman who never spared himself, who abounded in faith, hope, and love, and who never swerved from the straight and narrow way of righteousness and truth.

Trade with New Zealand.

THE report of the British Trade Commissioner at Wellington (Mr. N. Elmslie), which is reviewed elsewhere in this issue, indicates the continued prosperity of New Zealand and her growing importance as a customer for all classes of goods, particularly in the class in which our readers are most interested—electrical machinery and equipment.

Great Britain continues to be the principal supplier of necessities to the Dominion, but her position is not unchallenged. The United States is making a bold bid for trade in several directions, and Canada is said to be on the way to becoming a serious competitor in a number of branches of the electrical section.

There is undoubtedly a need for continued effort on the part of British manufacturers to consolidate their position in the market if they are to gain instead of losing ground. As in the case of Latin America, mentioned in our last issue, they must not rest on their oars, content with the good position which they undoubtedly occupy.

Probably the most valuable part of the reports which are sent home by our Trade Ambassadors is that which gives helpful advice to traders, based on actual contact with conditions in their particular countries. Mr. Elmslie, following the usual practice, puts forward a number of useful criticisms and suggestions which will be of interest and value to British traders. Again the need for "service" is stressed, and in a quoted example the United States method of ensuring this is commended. That thorough study of the market is essential goes without saying, but Mr. Elmslie states that in the event of personal visits being impossible, more reliance should be placed upon the reports of local agents who may be presumed to know what is wanted.

In the absence of indications to the contrary, it would appear that, generally, British prices are competitive. This being so, it seems that attention to the points brought forward in the report will ensure the maintenance and strengthening of the trade link which binds up to the progressive Dominion of New Zealand.

The Coal Mines Report.

ON another page in this issue we conclude our extracts from the report of H.M. Electrical Inspector of Mines, dealing mainly with accidents, and suggesting means for their prevention, which need no further comment on our part. It is, however, sad to think that, in addition to the loss of fifteen lives, there were also seventy non-fatal accidents, of which only ten might be judged as unforeseeable, and we are glad to note that the Inspector supports us in our contention that one way to prevent many of these accidents is to certify the electrical engineer and give him the status and responsibility that the importance of the undertaking demands. When we read that no fewer than three electricians lost their lives in circumstances that suggest—to quote the Inspector—"lack of that knowledge and experience which is necessary for the work they were undertaking," we may be excused for once again drawing attention to this matter.

The reports of the Secretary for Mines and the Chief Inspector of Mines contain much useful information bearing on the state of the mining industry generally, both financially and otherwise. Probably it is the financial position which is the most difficult for the layman to understand, in view of the misleading statements made by the officials of the Miners' Federation. The best quarter in 1923 was that ended June 30th, when profits, or rather credits, amounted to 3s. 2¾d. per ton, the total amount being £9,675,786, while, in addition, £1,599,007 was set aside for royalties, &c. There were 1,102,380 workpeople employed, so that, supposing the workers took every penny out of the industry, including both profits and royalties, it would only yield about four shillings per week each. By the end of the year, however, profits were reduced to 1s. 11½d., and since then they have continued in a downward direction. In addition, it is to be noted that during the same quarter 6,291,749 man-shifts were lost that could have been worked, which at 10s. per shift would have yielded £3,145,874 in wages, and about six million more tons of coal for disposal. In fact, during the year over 25 million shifts were lost. In view of these facts, we cannot put blame for the poor state of the industry on the shoulders of the owners, and it is easy to see what would happen after nationalisation.

It is to be regretted that the number of both fatal and non-fatal accidents was more than in the previous year, but even this question is being vigorously dealt with by the owners, who are instituting "safety first" campaigns. One hundred mines in Lancashire and twenty in North Wales, for instance, have "Safety First Committees," and it is now no uncommon thing, on visiting a colliery, to see "safety first" notices posted everywhere. Surely this is a worthy object in which one would think the British Miners' Federation would take very great interest, especially when it is considered that one-third of the accidents that take place are preventable.

The general position of the industry at the present moment is very far from reassuring. Mines unable to pay the minimum wages demanded by the Federation are closed, many others are losing money, a position which, of course, cannot be continued for long, and, considering all the circumstances, unless some means can be adopted for increasing the output and thus lowering costs, there is but a poor prospect before the industry. We sincerely hope that in the forthcoming meetings between the Coal Owners' Association and the British Miners' Federation reason and common-sense will prevail, and that an agreement will be come to which will benefit the industry and the community.

Gas and Electricity.

OUR reference last week to the desirability of co-operation between gas and electricity producers was quickly followed by further indications of a movement in that direction. At the annual dinner of the Liverpool Centre of the I.E.E., last Friday, Sir Max Muspratt, who is at the head of a very important branch of chemical industry, referred to the necessity of cheap electricity for chemical manufacturing purposes, which in other countries could be obtained from water power; in this country we must rely upon the use of fuel, employing the most economical systems and plant, and he quoted with approval a suggestion that gas and electricity works should be combined, the coal being first stripped of gas and the by-products recovered, after which the resulting coke would be pulverised for use in boiler furnaces. Assuming that the coal used is suitable for these processes—which is not necessarily the case—the combination is attractive; for the boilers require available heat irrespective of whether it is conveyed to them in the form of pulverised fuel or of gas, and thus the net output of gas and coke respectively can be regulated to meet the public demand without affecting the supply of electricity. But economy must be the keynote, and it may prove preferable to gasify the hot coke taken directly from the ovens, rather than to quench it and pulverise it when cold. Such questions call for investigation on the most broadminded lines, and, as Sir Max urged, with the co-operation of the great Institutions which represent the two industries.

We have heard of instances in the past in which electrical undertakers have sought co-operation with gas companies, but their addresses have been rejected by the latter; now that there are signs of a more responsive attitude on the part of the gas engineers, we hope that matrimony may result.

Charles Henry Wordingham.

THE death of Mr. C. H. Wordingham, C.B.E., on Wednesday last week, will be felt throughout the whole of the electrical industry as an irreparable loss, and by very many, including ourselves, as a personal bereavement. It was well known that Mr. Wordingham's health had failed nearly two years ago, and though he made a partial recovery, little had been seen of him in public of late; but few, we believe, suspected that he would never resume his place in the electrical industry. He died at his home at Redhill, after a long illness, at the age of 58, leaving a widow and five children.

That Mr. Wordingham had deserved well not only of the industry, but of the nation, needs no demonstration; he was devoted to the service of the public, and we have little doubt that his early decease was largely due to his tendency to overwork himself without mercy. His energy was inexhaustible, and his will-power amazing.

In our issue of October 19th, 1917, on the occasion of his assuming the Presidency of the Institution of Electrical Engineers, we outlined at some length the career of Mr. Wordingham up to that date. Briefly speaking, his career was divided into three main periods as central-station engineer, up to 1901; as chief electrical engineer to the Admiralty, from 1903 to the end of the war; and as consulting engineer before and after his service under Government. He was a brilliant student of King's College, London, and enjoyed the distinction of pupilage to Dr. John Hopkinson, as well as service under Mr. S. Z. de Ferranti at the Grosvenor Gallery generating station and at Deptford. In 1892 he became Dr. Hopkinson's resident engineer, supervising the erection of the generating stations at Whitehaven and Manchester, and two years later he was appointed chief electrical engineer to the Manchester Corporation. In that capacity he developed the undertaking from 2,000 kW to 50,000 kW, and worked out a scheme for the supply of a district of 45 square miles at 10,000 volts on the three-phase system, thus laying the foundation of what has since become the largest municipal electrical undertaking in the Empire—probably in the world.

Photo by [*Elliott & Fry*

Charles Henry Wordingham, C.B.E.

Resigning this appointment in 1901, Mr. Wordingham set up a successful practice as a consulting engineer, but two years later, on the invitation of the Board of Admiralty, he accepted the new post of electrical engineer-in-chief. At that time the use of electricity in the Navy was in an early stage of development, and was carried out on primitive lines.

It was, we think, the crowning achievement of Mr. Wordingham's career to sweep away the old-fashioned methods that were in vogue and to establish on a sound and up-to-date engineering basis the whole of the electrical installations on board ship and in the Naval dockyards. He introduced many new designs, reorganised systems, and raised the standard of naval electrical engineering to a level at least equal to that of any other branch of engineering under the control of the Admiralty. The excellence of his work was manifest in the splendid record of the electrical installations on sea and land throughout the war—the most searching and rigorous test that they could possibly be called upon to undergo. Moreover, Mr. Wordingham was adviser to the Admiralty on all questions connected with electrical engineering, such as the equipment of the great Dockyard at Rosyth and the naval air stations that were established during the war. It is for these reasons that we claim that he rendered pre-eminent service to the State, and that his work contributed in no small measure to the successful outcome of the war.

Even whilst the issue of the conflict still remained uncertain, the Institution of Electrical Engineers bestowed upon Mr. Wordingham the highest distinction in its power by electing him, in 1917, to the position of President. He had already served the Institution faithfully and well in various capacities; he was one of the earliest members of the Wiring Rules Committee, a valued member of the Engineering Standards Committee, and chairman of the Electrical Research Committee. His Presidential address was a monumental work in itself, crammed with ideas and proposals for the welfare of the Institution and of the electrical industry, and was delivered with a vigour and emphasis that offered no hint of declining physical powers. Amongst other important projects that he foreshadowed was the obtaining of a Royal Charter, an ambition which he had the happiness to see fulfilled, together with several other of his farsighted plans. So hard did he work during his year of office—robbing himself of sleep in order to fulfil his dual duties to the Admiralty and to the electrical industry — and so highly esteemed were his efforts by the Institution, that he was invited to continue in office for a second year, in order to carry further his schemes for the good of the industry. After the Armistice Mr. Wordingham retired from the Admiralty, and returned to private practice as a consulting engineer, in which capacity his services were in great demand up to the time of his death.

Of the many other distinctions conferred upon him we may mention the award of the C.B.E.—certainly not an excessive acknowledgment of his work at the Admiralty—and the office of President of the I.M.E.A. (of which he was subsequently made an honorary member), of the Junior Institution of Engineers, and of the Illuminating Engineering Society. He was an Associate of the Institution of Naval Architects, a member of the Institutions of Civil and Mechanical Engineers, and of the French Society of Civil Engineers, president of the British Electrical and Allied Industries Research Association, a founder of the E.D.A. and of the Society of Radiographers. He was an enthusiastic supporter of standardisation and research, and did his utmost to establish a National Proving House. He was an occasional contributor to the technical Press, including our own columns, and the author of a one-time standard work on "Central Electrical Stations."

As a man he was deservedly popular, courteous and accessible and full of goodwill towards his fellow men. His innumerable friends will join with us in tendering heartfelt sympathy to his widow and children in their heavy bereavement.

Notes on Loud-Speaker Design.

By MORTIMER A. CODD, F.Ph.S.

A GREAT deal has been written on the theoretical principles which should be followed in the design of loud speakers, but it is difficult to find amongst these generalities any definite rules governing their mechanical and electrical structure; hence the following experiments may be of interest to practical constructors.

The loud speaker may be regarded as an electromotor converting electrical into sound energy, the problem being how best to effect this without distortion.

As a matter of fact, the better class of loud speaker is singularly free from distortion when not overloaded, any distortion present being largely due to defects in the preceding circuit. Strictly speaking, loud speakers should be marked as to their maximum input without overloading.

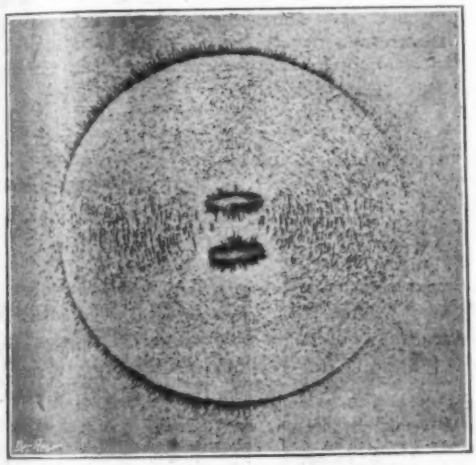


Fig. 1.—Magnetic Field of Diaphragm.

Following the analogy of the electromotor, we have on one side of the diaphragm the electrical system, which must be tuned in sympathy with the frequency of the incoming electrical pulses, and on the other the acoustic system arranged to propagate the maximum sound energy into the surrounding air, but intimately coupled with the electrical system.

Naturally, one's first efforts are directed at devising some sort of trigger arrangement whereby the incoming current can be employed to release energy from a local circuit or some other slave mechanism.

The writer tried numerous experiments on these lines without marked success, particularly where fidelity of reproduction was concerned; indeed, it is remarkable that the simple conventional diaphragm arrangement gives such perfect results. Considering first the magnetic system, we have the permanent magnet attracting the diaphragm with a pull P. Superimposed on P is the additional impulse p occasioned by the pole windings, which may be either positive or negative in value, thereby tending to confirm the attraction of the diaphragm or to release it.

If P is great in relation to p, the diaphragm will be strongly attracted, but very little displacement will result. Additionally, the pole shoes and particularly the thin diaphragm will be magnetically saturated, and even were signals audible, distortion would be present.

Alternatively it would seem that if P is of a strength approximating to p, the best results should be obtained. Unfortunately this is not so, due doubtless to the reluctance of the air gaps between the pole shoes and diaphragm. An electromagnetic control was arranged in which P could be varied by means of a sliding resistance in series with a few cells. The best results were obtained when the magnetic strength was what may be generally described as of only medium strength. This was confirmed by using batteries of permanent magnets as well to vary P. One fact, however, emerged—that is, for every value of P or perhaps more correctly for every form or variation of the permanent magnet, the windings have to be varied, because the shape of the magnet has a direct bearing on the impedance of the pole-shoe windings.

The correct impedance in relation to the strength of the magnets is a matter of trial and error, but I have found that by winding the magnets in parallel better results can be obtained than by the series arrangement, presumably because the impedance is lowered.

The correct size of the pole shoes depends on the maximum area of diaphragm the shoes can conveniently subtend, and this again will govern the ampere turns of the winding.

Experiments tend to show that the pole shoes should not be greater in width than 1/5th the working diameter of the diaphragm.

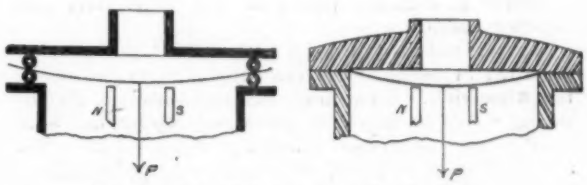
The reason for making the poles as wide as possible is the extremely small sectional area of the diaphragm through which the magnetic circuit is completed. Magnet shoes with the terminations hedge-hogged fanwise at the tips to give extended area met with no success, neither did thickening the diaphragm towards the centre, nor the use of an iron ring as used in the Ader telephone.

The optimum distance between the pole shoes would seem to be equal to their width, so that the shoes lie on two sides of a square.

If this distance is lessened there is danger of the centre of the diaphragm touching the shoes in its maximum excursions, while if the distance is exceeded the results are not so good and the reluctance of the magnetic path is increased.

Experiments carried out on a pole shoe 9/16th in. wide and 3/32 in. thick with a magnetometer showed that there was only the slightest falling-off of the curve of magnetisation when 200 ampere-turns were reached.

As these shoes form part of a composite magnetic circuit, this may not entirely be conclusive, but it is enough to show the quantity of iron present is vastly in excess of that required; indeed, its dimensions are usually governed probably more by manufacturing than magnetic considerations.



Figs. 2 and 3.—Methods of suspending Diaphragm.

For example, using a low-resistance loud speaker, quite good reception is possible with currents under one milliampere; loud reception in an average living-room with 2 milliamperes or, say, 1.8 ampere turns per pole, and very loud signals indeed, suitable for a large hall, with 30 mA on, say, 27 a.t. per pole. It should be remembered that these readings are r.m.s. values, and the peak values therefore are several times as great for a very small portion of a second.

These currents were measured by means of a vacuo thermojunction milliammeter and are broadly correct, but owing to the transience of the signals recorded,

anything like an accurate reading is difficult to obtain; thus, the tuning note of 2 LO (fig. 5) long-sustained will give a much higher reading than an intrinsically louder note for a short period.

As previously remarked, the ampere-turns of the winding will depend on the size of the pole shoes, but the turns will further be governed by the strength and shape of the polarising magnet. For example, the poles with their windings can be taken from any magnet that they work with and attached to a magnet of approximately equal strength but larger in size, and yet the signal strength may be much weaker, presumably due to some alteration in the impedance of the coils.

The gauge of wire employed does not seem to have much effect, provided the turns are as close as possible to the magnet shoe and as near the end of the pole as manufacturing facilities permit, since the minute currents circulating are easily accommodated by the finest instrument wires in common use.

Experiments were also carried out with various diaphragms. Corrugating the diaphragm was found to give better results, particularly where the sheet metal was not originally entirely flat, although a truly flat diaphragm gives probably the best results of all. The fact, however, that the disk is stamped from the sheet in a press must necessarily impose stresses round its periphery, which it is essential to get rid of, or at least neutralise.

There are two methods by which the diaphragm may be suspended, the first being that shown diagrammatically in fig. 2, in which the diaphragm is flexibly suspended between two rubber or other similar gaskets. With this arrangement the whole diaphragm flexes, pivoting mainly about two points in the centre of the rubber gaskets.

In the second arrangement the diaphragm is rigidly clamped between two metal rings, fig. 3.

In this case the diaphragm bends as before from its centre, but cannot pivot at its circumference; therefore there are two other points of flexion at the junction of the metal clamping rings.

Such an arrangement will have a higher natural frequency than the first described, since its working diameter is reduced, but does not necessarily give inferior results.

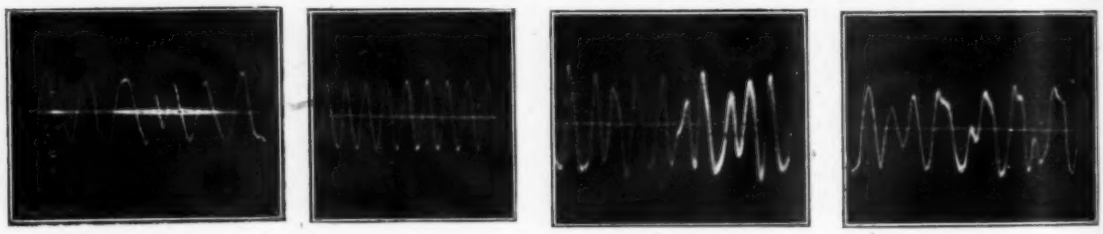
A modification of this last method tried by the writer consisted in sweating the diaphragm circumferentially to a brass ring. On cooling, the ring contracts, thereby giving a slightly curved shape to the diaphragm. Such a diaphragm disposed concavely, regarded from the magnet side, gave excellent results when receiving signals of high periodicity, but was poor on vocal or musical frequencies. Reversing the diaphragm so as to present the convex side to the magnets gave poor results at all frequencies.

The next experiment consisted in turning the clamping rings very slightly concave, so as to give a slight initial set to the diaphragm similar to that shown in the position depicted in fig. 2. This arrangement gave by far the best results, presumably because, without the use of corrugations, the diaphragm is constrained to take up a definite position at its centre without any trace of "floppiness" such as results with the more conventional methods of securing its circumference. In any case it is essential that the anchorage of the diaphragm and sound box and the abutment of the magnet poles should be very massive, a point which frequently seems to be lost sight of in loud speakers, otherwise both the diaphragm and the magnets and casing vibrate with consequent loss of signal strength.

We may now consider the diaphragm in relation to the acoustic side of the mechanism.

First, it is necessary to provide some damping arrangement whereby any distortion due to natural resonances in the diaphragm may be as far as possible mitigated. This damping is best supplied for the most part by the load of the horn.

If the horn is improperly proportioned, one or more notes will cause "blasting" in the receiver mechanism itself, such as may be heard when the horn is removed. It should be fully realised that the diaphragm works exactly like a pump or the mechanism for producing vortex rings; thus, if a light aluminium plunger be affixed to the diaphragm and arranged to work as a piston in the end of the horn (which may be completely detached from the usual sound box) excellent results are obtained. Additional damping may be secured by arranging the diaphragm to lie very close to the cover of the sound box. As the amplitude of the centre of the diaphragm is very small even with the loudest signals, this distance can usually be as short as 4 or 5 thousandths of an inch since the main pull P of the magnet is drawing the diaphragm downward. The use of a large space between the diaphragm and the sound box, besides lessening damping, gives the effect of an air-cushioning chamber tending to weaken the volume of the issuing signals. The opening from the sound box connecting with the stem of the horn was arranged to vary by means of an adjustable shutter. Openings as small as 1/16 in. in diameter would give quite remarkably good results, but the best aperture appears to be in the neighbourhood of 1/5th the working diameter of the diaphragm. Larger apertures do not appear to be so good, possibly because the greater volume of air displaced moves at a less than proportional velocity.



"Big Ben," 500 cycles; peak value 32 mA. | 2LO tuning note, 1,000 cycles; peak value 28 mA. | Saxophone, 900 cycles; peak value 50 mA. | Ukalele, 600 cycles; peak value 40 mA.

Figs. 4 to 7.—Oscillographic Note Records.

The horn itself may be regarded as consisting of two parts—the stem, the more important member, in which the immediate energy from the diaphragm is expended, and the flare, which serves to disseminate the sounds received more or less agreeably into the surrounding atmosphere.

Various proportions for horns were tried, but the logarithmic arrangement seems undoubtedly to be the best. Broadly speaking, short wide horns give the best local results, while long horns project the sound to a greater distance. Various materials were also experimented with, such as sheet metal, wood, cardboard, and the like, but the best effects are undoubtedly obtained when the horn, particularly the stem, is of heavy and rigid construction and intimately mechanically connected with the heavy sound-box lid.

Lighter constructions appear to be subject to resonances and false notes of their own, prejudicial to clear and truthful reproduction.

Experiments were conducted in which two receivers shared a common sound projector, but the results were relatively poor. It appeared as though there was interference beween the two sets of sound waves, mutually destructive.

Very pleasant results, however, can be obtained by using two separate loud speakers a few feet apart, one tuned to relatively high notes and the other to low, the effect being, as it were, stereoscopic.

The Physical Society of London.

Annual Exhibition of Instruments.

(*Concluded from page* 193.)

Nalder Bros. & Thompson, Ltd.

One of the attractions of this exhibit of electrical measuring instruments and protective relays was an improved form of precision wattmeter of the dynamometer type, all parts of which had been exposed for inspection. These instruments have recently been completely redesigned, and many important improvements have been introduced. The moving system is extremely light and the instrument is dead beat; the damping device consists of two very light symmetrically disposed vanes, which are enclosed in chambers made as nearly airtight as possible. The frame supporting the field coils is made of a special high-resistivity material, and is so shaped that eddy currents are reduced to a negligible quantity. The sub-standard instruments are fitted with knife-edge pointers and

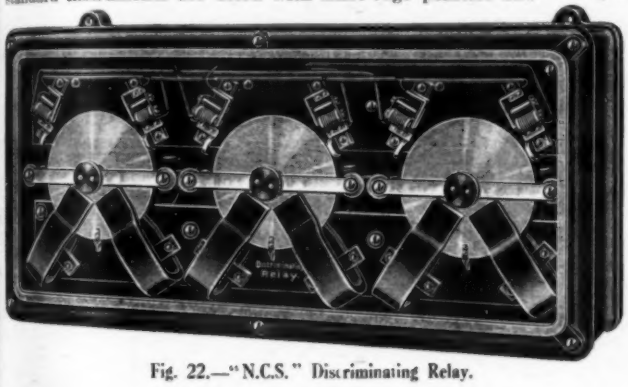


Fig. 22.—"N.C.S." Discriminating Relay.

mirror scales, and the readings can be taken with great precision, and special steps have been taken to eliminate as far as possible the errors due to self-heating. These instruments are supplied in the switchboard, portable and sub-standard patterns, whether for single-phase or polyphase circuits. The N.C.S. "Ideal" series of instruments now includes recording (graphic) power-factor and frequency meters. The movements are similar to those of the respective indicating patterns (Nalder-Lipman type), and the recording mechanism is of a tapping pattern which is quite independent of paper friction. It is claimed that these recorders have the same high degree of accuracy as the indicating pattern N.C.S. power-factor and deflectional frequency meters. A small portable phase sequence indicator was also exhibited which shows at a glance the sequence in which the e.m.f.'s reach their maximum values; the windings are quite suitable for voltages from 50 to 500 volts at any commercial frequency. The company is now manufacturing a line of relays for the protection of mains and feeders against overloads, leakage, and reverse current; the "N.C.S." discriminating relay (fig. 22) for the protection of parallel feeders in operation depends upon the balance of current only, and is quite independent of potential. Normally the load is equally divided between the two parallel feeders and correspondingly equal currents (derived from the secondaries of current transformers) flow through the windings of the two electromagnets of the relay, and due to the balance of their opposite torques the moving system remains in the zero position. Should, however, a fault develop on one of the feeders, then the faulty cable will, in general, carry the heavier current, and if the out-of-balance current reaches the value of the setting of the relay, the latter will operate accordingly.

W. Edwards & Co.

This company's latest development is the production of an extremely compact outfit for producing high vacuum. The set consists of a motor-driven "Hyvac" pump acting as a backing pump for a fused-quartz mercury-condensation pump, all mounted on a base 24 in. by 9 in. The former is two-stage, and will produce a vacuum of 0.001 mm., consisting of two distinct rotary pumps on a common horizontal shaft immersed in a special oil of very low vapour pressure; the oil prevents any air leakage into the high vacuum. The quartz "Vitreosil" pump, with a backing pump giving a vacuum of 0.2 mm., will produce a vacuum of 0.000002 mm. readily, and the speed is about 200 cu. cm. per second, its total length being 25 cm., the diameter of the outside barrels 3.3 cm., and of the gas inlet 1.5 cm. The pump is water-cooled, and a liquid air trap is required to remove the last traces of mercury vapour. The pump can be either electrically or gas heated, and will work effectively with only 5 cc. of mercury.

The all-metal annular-jet vacuum pump, which has been made to the designs of Mr. Ivor Backhurst, M.Sc., and Dr. G. W. C. Kaye, O.B.E., M.A., D.Sc., combines facility of construction and high efficiency, and the advantages of the jet and condensation principles in a single and readily accessible unit. It will readily produce a vacuum of the order of 0.00001 mm. of mercury or less when working against a back pressure of 1 mm. of mercury. Fig. 23 shows the details of the construction, which is so carried out that all the inner parts of the pump may be lifted out together, and can be readily unscrewed, which makes cleaning exceptionally easy. The deflector and sleeve S may be screwed up or down to the position giving the maximum speed over the pressure range desired. Mercury vapour from the boiler passes up the centre tube and through holes at the top of the annular space between the deflector and the sleeve S, from which it issues as a jet and entrains gas diffusing from the annular space between the deflector and the outer casing. In the region between the casing and the sleeves S and C, condensation of the vapour takes place, the condensed mercury falling through the hole in C, immediately above the return tube to the boiler. The sleeve C serves to prevent any mercury vapour which may leak from the boiler through the annular crevice, and the several screwed joints just above the boiler, from interfering with the vapour jet between S and the outer casing on which the pumping action depends; at the same time it prevents the condensing vapour from this jet from coming into contact with the hot central tube. Since the lower and wider part of C is in contact over an appreciable area with a water-cooled part of the outer casing and is separated from the top of the boiler by three pins, it remains comparatively cold, so that the condensed mercury falling on the sloping channelled part of C is not largely re-evaporated as would happen were it to fall directly on the top of the boiler. It is therefore possible to use a large Bunsen burner and operate the boiler at a comparatively high temperature without any likelihood of failure due to overheating.

In this way the blast of vapour obtained is sufficient to supply the annular jet, which has a width of 1.75 mm. and an actual jet area of 2.85 sq. cm. On account of the greater efficiency of the annular jet compared with the circular form, much higher speeds are obtained over the usual jet-pump

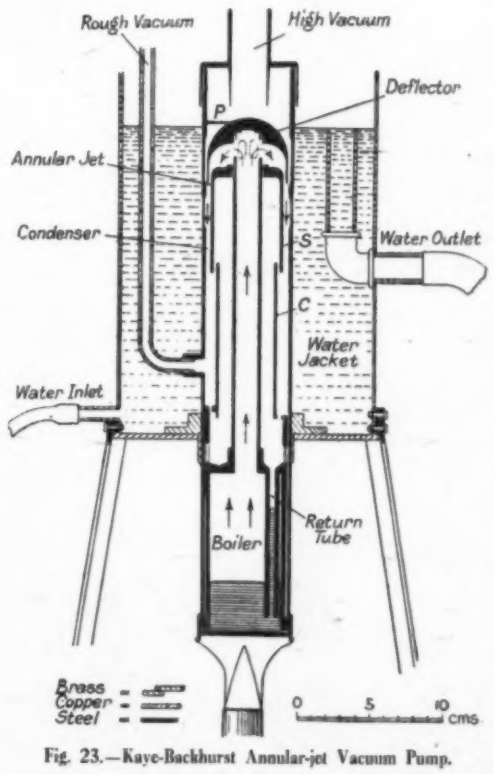


Fig. 23.—Kaye-Backhurst Annular-jet Vacuum Pump.

pressure range. At lower pressures also the pump is still able to operate, functioning then as a condensation pump, though its speed as such is necessarily restricted by the narrow width of the jet. The pump could readily be adapted for electrical heating instead of gas; the amount of mercury required in the boiler is about 70 c.c. (2 lb.), and at pressures between 0.001 and 0.5 mm. mercury, the speed varies between 1,000 and 7,000 cc./sec.

H. Tinsley & Co.

This large exhibit consisted, amongst other things, of a good selection of precision resistances and potentiometers of excellent design and finish. The 'Tinsley" vernier potentiometer is one of the most accurate on the market, and the ingenious arrangement of the Thomson-Varley principle and the series of coils has made available an instrument in a convenient form and of great precision for those who object to a slide wire. It is in use in various Government Departments in the United States, the National Physical Laboratory, and other institutions. The Kelvin double bridge, with standards, is being taken up commercially and proving its value in cable works, &c., where heavy sectional copper resistance is required to be measured. Dr. A. B. Wood's cathode-ray oscillograph has been brought to a convenient form and will find a useful sphere where very quick periodic current is to be measured. Other forms of resistance coils and standards were shown and some new circular-dial forms of Wheatstone bridge with sliding contacts that have been so designed as to be practically equal to a plug resistance box.

Mr. D. C. Gall's potentiometer is interesting as an instrument which is capable of measuring a.c. vector quantities, in which small phase angles are involved, to a high degree of precision; it should be valuable to research workers, and is being used by some of the large telephone manufacturing companies. The variable inductometers shown by this firm have an ingenious combination of coils, due to Mr. Butterworth, arranged in decade form so that the intercapacity is extremely small. Dr. Drysdale's wattmeters are being largely used when power is required to be measured accurately, such as in cable and transformer testing. Various speed devices, based upon the stroboscopic principle were also shown, notably the phonic chronoscope and the strobometer, in addition to standard mica condensers with special shields for making the earth capacity a definite value in testing at high frequencies.

A. C. Cossor, Ltd.

A display of bright and dull thermionic valves for radio reception and a display of miniature lamps, including miners', hand lamps, electric sign, automobile, telephone switchboard signal, and surgical instrument lamps.

Creed & Co., Ltd.

Exhibits illustrative of developments in high-speed telegraph machinery, the principal items being a column printer, keyboard perforator, an improved relay (1924 design), Morse transmitter, and a receiver.

Damard Lacquer Co., Ltd.

This company manufactures synthetic resin products, such as "Formite", and Bakelite, but not the finished articles, *i.e.*, laminated and moulded insulation, &c., which were shown by the courtesy of customers. Cements, varnishes, "Damarda" acid-resisting and "Biscolac" lacquers were also exhibited.

Darimont Electric Batteries, Ltd.

This type of battery is a two-fluid primary cell, in which chemical and physical reactions take place, producing and automatically maintaining a semi-pervious membrane between the exciting and depolarising solutions, thus preventing diffusion of the liquids. The e.m.f. is about 1.5 volts, and the internal resistance is practically constant. There is no smell or crystallisation of salts, and no loss of zinc on open circuit. The cell is easily and inexpensively re-charged, may be used continuously or intermittently, and it is not damaged by short circuit.

Dubilier Condenser Co., Ltd.

The principal exhibits consisted of radio condensers of various patterns, the "Duwatcon" being a new form of variable condenser specially constructed to overcome the gap in the tuning range which exists when an ordinary type is used in the aerial circuit as a series-parallel condenser. Other devices shown included the "Ducon," anode resistances, grid leaks, "Minicap" key switches, mica insulators, a short-wave heterodyne wavemeter, and a neon-lamp wavemeter which utilises the lamp as a resonance indicator, thus eliminating the risk of burning out the indicating lamp by excessive coupling to the oscillation circuits.

Edison Swan Electric Co., Ltd.

In addition to Pointolite lamps of various sizes, from 30 to 4,000 c.p. for operating on d.c., the company also showed a 150-c.p. pattern for use with a.c. A special type is made for pyrometric work, and an important feature of the lamp is its suitability for use with a deep paraboloidal or ellipsoidal reflector utilising an enormous flux of light; in projection work the coolness of the beam is another advantage.

Igranic Electric Co., Ltd.

This company showed a range of useful radio components; apart from familiar goods, some attractive variometers were shown. The B and BL types are remarkable for the fact that the windings are self-supporting, the use of moulded material for supporting the stator and the rotor having been practically entirely eliminated. A tube which surrounds the windings is entirely for protective purposes, and as its plane is not parallel to the coils, excepting for a very small part of the winding, it introduces a comparatively negligible value of self-capacity. In type F the mass of moulded material which one usually associates with variometers has been eliminated by skeletonising the mouldings upon which the present H-type variometer is wound. The Igranic-Freshman fixed condenser is interesting; its construction is such that variation in capacity is practically negligible, due to the fact that the flattened tube in which the electrodes are contained is subject to a very heavy uniform pressure, and in manufacture this pressure is applied in such a manner that it remains constant throughout the life of the condenser. Models of the "Unitune" aperiodic fixed coupler were shown, their particular merit being that they are suitable for very short wavelengths of the order of 75 metres, and also are selective both for the broadcasting wavelengths and the short-wave telephony. A new variable grid leak is manufactured upon a similar principle to a new type of potentiometer having a resistance of the order of 50,000 ohms, which should be found useful where potentiometers with dry cells are used for grid bias on low-frequency amplifying valves. The high-frequency transformer design of this company employs the honeycomb method of winding, and gives high efficiency; the intervalve transformer is much larger than the old type, due to the fact that it contains more iron and more copper than its predecessor.

The India Rubber, Gutta Percha & Telegraph Works Co., Ltd.

Various types of telegraph instruments were shown, including Wheatstone automatic receiver and transmitter, perforator, single current galvanometer, double current key, rheostat, Gulstad relays, &c. Of portable testing sets four types were shown, two of which are designed for the measurement of conductor and insulation resistances; one for the measurement of insulation resistance only, suitable for pressures up to 500 volts; one a cheap form of Wheatstone bridge, complete with galvanometer for workshop use; also radio accessories of various types were shown, including low-frequency transformers, head telephones, condensers, a loud-speaker, &c.

A. Gallenkamp & Co., Ltd.

This company exhibited electric furnaces; an outfit for assisting power plant to realise fuel economy and abate smoke, consisting of calorimeters for determining the calorific value of fuels, apparatus for estimating the ash, moisture, and volatile contents, Lessen coking gear, apparatus for carrying out the low- and high-temperature assay of coal for carbonisation purposes; and electro-titration sets were also on view.

Gambrell Bros., Ltd.

This range of instruments included Wheatstone bridges, galvanometers, potentiometers, resistances, condensers, switches, &c., and a selection of "Efficiency" radio receiving apparatus.

John J. Griffin & Sons, Ltd.

On this stand a bomb calorimeter was noticed, which is made entirely of stainless steel. Other items were Sand's apparatus for electrolytic analysis, a new pattern of quartz glass, and platinum gauze electrode for gravimetic work, hydrogen electrodes, potentiometers, a laboratory electric furnace, &c.

Marconiphone Co., Ltd.

This company's exhibit included two broadcast receivers, together with components which are incorporated as standard in its instruments. Both the receivers were fitted in special cabinets to enable the assembly, wiring, finish, &c., to be inspected.

M. O. Valve Co., Ltd.

The selection of valves shown included water-cooled transmitters capable of taking an input up to 20 kW at an anode voltage up to 12,000 V. The No. 3 rectifier is capable of rectifying currents up to 100 millamperes (r.m.s.) at potentials up to 75,000 or 150,000 volts, dependent on whether a capacity or resistance load is being used. The filament, taking 8 amperes at 8 volts (maximum), is almost entirely enclosed by a molybdenum anode system. A number of high-power rectifying and transmitting valves in which the electrode systems are constructed almost entirely of molybdenum were shown. The latest types embody a maximum power capacity with a minimum of impedance, the maximum filament current consumption being 25 amperes, and the maximum anode voltage 12,000. A series of dull emitter receiving valves for miscellaneous purposes included the D.E.7 four-electrode valve, taking a filament current of 0.4 ampere at 1.8 volts. The L.S.5 type is specially suited for low-frequency amplification where considerable volume is required; it needs a filament current of 0.8 ampere at 4.5 volts, gives a filament emission of about 60 milliamperes, and can also be used as a low-power transmitter at anode voltages up to 400. This type is also extensively used for telephone repeaters.

Mullard Radio Valve Co., Ltd.

In addition to the Holweck molecular pump, resistances, condensers, and sockets, a large variety of valves was on view. The D.06 h.f. and l.f. types are designed to run off dry batteries, while the DFA3 is a power amplifier with a dull emitting filament taking 0.06 A, and is suitable for use with dry cells. Wecovalves and transmitters and rectifiers were on view, including transmitting valves in silica envelopes for powers up to 10 kW.

Record Electrical Co., Ltd.

Besides the "Cirscale" range of instruments and tachometer, circuit breakers, battery cut-outs, testing sets, &c., there was shown a change-coil volt-ampere testing set which has two moving-iron movements arranged at each end of the case. The voltmeter is provided with a fixed coil and series resistance brought out to terminals at the top of the case, giving five ranges of voltage from 1 to 750. On the current side, a change of range is produced by changing the series coils that are slipped over the moving-iron element, which is protected by a sleeve and held in position by guide rods and clamped by wing nuts; six coils are provided in the standard model, giving ranges from 0.1 to 600 amperes. Each range has a separate scale marked on a drum, which is made to rotate by depressing two knobs at the end of the drum, thereby overcoming the disadvantages of having many scales on the one dial. All the coils are housed in a receptacle in the case, and the instrument is of convenient shape for carrying; the total weight does not exceed 11 lb.

Weston Electrical Instrument Co., Ltd.

This company exhibited a selection of instruments, amongst which thermo-ammeters and galvanometers for radio frequencies were noticed, as well as a new size of round a.c. and d.c. switchboard instruments. The reduced space occupied by a number of items is the principal feature of the firm's new line of rectangular instruments for a.c. switchboards, the pleasing appearance and bold scare being noticeable.

A Newly-Designed Induction Motor.

Messrs. Higgs Bros.' First Change of Design.

THEIR products having been described from time to time in our columns, Messrs. Higgs Bros. need no introduction as electric motor manufacturers. They have been producing induction machines for the last eight years, their policy having hitherto been to make no change in design. They do not believe in regularly making alterations to their products, as to do so must necessarily cause customers some inconvenience.

However, the time arrived when Messrs. Higgs found that they could cheapen their product and at the same time improve its performance, and, accordingly, a complete new line of "G" and "H" induction motors has been put on the

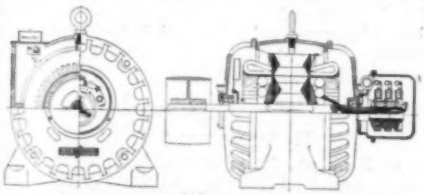


Fig. 1.—Higgs Re-designed Motor; Section.

market, the former type being fitted with a wound rotor and the latter with one of the squirrel-cage pattern, the limits of power being between 0.6 and 52 h.p. at 50 cycles.

To ensure that the line of machines shall be competitive 16 frames are made, and some of the salient features of this range of motor, which is illustrated in the accompanying figures, are as follows: Hoffmann ball or roller bearings are fitted throughout; the same size it fitted at each end of the rotor, and all standard stock machines are suitably insulated for use in tropical climates and humid atmospheres. The sectional general arrangement of the machine is shown in fig. 1. The terminal box is an integral part of the motor, as

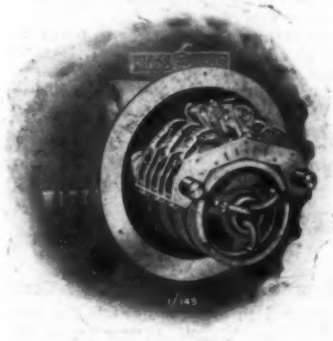


Fig. 2.—Slip-ring Gear without Cover.

indicated in fig. 3, thereby eliminating projections, and no brass castings are used in the production of these machines.

A box containing the necessary spare parts, including a supply of bearing grease, is fitted to the slip-ring machines.

The ventilating system is a good one, and it will be noted that there is a complete circulation of air round the rotor and stator windings.

The squirrel-cage motors are fitted with what is claimed to be an "indestructible" winding. Gap inspection holes are provided, and the stator is ground internally and the rotor

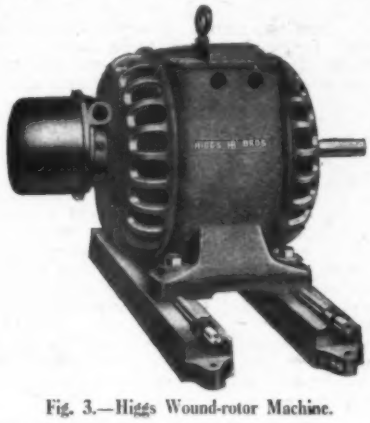


Fig. 3.—Higgs Wound-rotor Machine.

externally, the gap being within 10 per cent. of the calculated dimensions, and Messrs. Higgs guarantee the rotor to be concentric. Two brushes per ring are fitted to wound-rotor machines; while the slip-ring gear (fig. 2) is totally enclosed. The machines are guaranteed for two years.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

The Radio Manufacturing Industry.

January 1st has passed and there is still a radio manufacturing industry in Great Britain. We were told that as soon as the flood gates were open the water of foreign competition would flow in and overwhelm us.

Judging by manufacturers' deliveries, this doleful prophesy has not come to pass, nor will it if the trade, wholesaler and retailer alike, supports the manufacturer. We are a nation with an ever open door to the foreigner. Our pity and our alms are always for him first, domestic considerations take second place. The radio industry ask neither pity nor alms, but only a square deal. Let us consider its history a little to clarify our views of the present.

Early on, before the advent of broadcasting in this country, there were one or two, probably three, radio manufacturers supplying the needs of the experimenter, a class of radio enthusiast to whom in large measure is due the evolution of the art to its present perfection. These manufacturers, pioneers in their sphere, provided the first essentials on which the present industry has been built. Broadcasting came, and like everything else, needed financing. British capital and British brains alone and entirely provided this necessity. The larger electrical manufacturing interests came together, submerged their own individualities and in conjunction with the pioneers the British Broadcasting Company was launched on the seas of commercial uncertainty. The effort was entirely British both in finance and direction.

Having sown, it was expected that there would be a reaping, but legislation, a misguided newspaper propaganda and national impecuniosity produced a slump—bitter days for those, pioneers and investors alike, who had, some of them, their all invested in a national service. They stuck to their guns, however, and saw it through and slowly, but surely, gained a firm footing, establishing an industry and a name for British manufacture second to none. At a time of great national commercial depression the radio industry has boomed and its members have maintained their commercial supremacy.

At the present time there is no broadcast service so good as the British and no radio products are so good as the British-made radio products. This is known throughout the whole world as is proved by the present export position. The manufacturer calls the particular attention of the whole trade to this vital point.

The manufacturer needs a distributor and the trade, wholesale and retail, came into being, consolidated by the efforts and on the initiative of the British manufacturer.

Fortunes have been made in the trade and business established and consolidated by this same effort of the British manufacturer who now and in turn has a right to expect the support of the trade against foreign competition. All import restrictions on the importation into Great Britain of foreign radio material were lifted on January 1st. It is said that retailers and wholesalers are loading up with stocks of foreign made radio apparatus. If this is so, then it is a very short-sighted policy indeed on their part which will come back on their own heads when they least expect it. There may be a

demand for these products for a time, but "British Made" will win out in the long run. A comparison may be drawn with the early days when large imports were made of French head telephones. How many will confess to their back shelves still being full of this same stock, unsold and unsaleable?

It may be assumed that the Press by comment and advertisement will encourage willingly or otherwise the sale of imported goods. Time will prove, but again it would be a short-sighted policy. Where does their main income come from? Is it not from the British manufacturers and is it not to their best advantage to support them to the full extent, even to the exclusion of the foreigner?

One radio protective society has very rightly decided not to admit foreign made radio apparatus to its schedule. This has been done in no unfriendly spirit, it simply means that charity, or rather the daily bread, starts and stays at home and everything in our power must be done to support our own national products even if it excludes those of other nations.

There are certain greivances which the trade has against the manufacturer and likewise the manufacturer has his own growls against the trade. Foreign goods may well be such a grievance and to those who feel it to be so the viewpoint as here set out is commended to their very careful and sympathetic consideration.

With friendly co-operation, there need be no feeling of apprehension for this or the coming year. The British radio industry is established, securely and in accordance with the best traditions of our race.

Alec.

London, *January 27th*, 1925.

Gas and Electricity.

As you state in your issue of the 30th, the compliment paid to electrical engineers by the Institution of Gas Engineers is an incident denoting a most welcome *rapprochement*.

The gas engineer has made a special study of the conversion of coal into other forms of heat and valuable by-products, while the electrical engineer has studied the conversion of heat into electricity with great benefit to industry and the well-being of mankind. A joint effort to efficiently solve the problem of conversion of the valuable energy stored in coal without the destruction of other constituents is most earnestly to be desired.

While some of us have suffered severely from the short-sighted policy of gas interests, we must realise that there are some long-sighted gas engineers with whom we shall be delighted to work in complete harmony.

May the mischief done to electrical development in 1882, and since, be repaired by the joint endeavours of all those who take for their motto "The utilisation of the forces of Nature for the benefit of mankind," leaving the forces of greed to be chastised by the imprecations of posterity.

January 31st, 1925. **William Bones.**

The Late Mr. C. H. Wordingham.

I cannot help feeling that, apart from his own professional work, our friend's too early death may be indirectly traced to extraordinary activity in the interests of the profession of which he was so distinguished a member, and, though the Institution of Electrical Engineers has been fortunate in many zealous Presidents—from the days of Dr. Ferranti onwards—as an onlooker I venture to think that Wordingham has never been surpassed as a pioneer in the cause of the Institution and its members.

I have a lively recollection of lunching with him at the St. Stephen's Club on the day when he was going to deliver his inaugural address. It was full of suggestion, so much so that I ventured to express a hope that some of it might be reserved for another occasion—or even other occasions. In his enthusiasm, however, he was anxious to throw it all off at once, so that his proposals might be all the sooner followed up.

As we all know, it was certainly an address that inspired thought—though some of us may not entirely have agreed with him—and action soon followed.

To know Wordingham was to love him.

Harlow, *January 31st*, 1925. **Charles Bright.**

The Kearney Railway.

The letter by Mr. Klapper in to-day's issue and the editorial a fortnight ago lead me to ask for information.

Speaking from memory, when the Kearney Company prospectus was made public, the only patent I discovered was the combination of an overhead rail "straphanging" with a double-flanged wheel underrunning—quite harmless in the engineering world, because quite useless.

At the initial exhibition of models at Aldwych it was made clear that there was no appreciation of the power necessary to bring a car from the low point up to the station, if for any reason the car were stopped at the low point.

Has the company ever had a patent of practical value? The one mentioned required a tube to support the fixed part of the combination.

Many re-readings of papers have been announced, but nothing that would appeal to a practical engineer has ever reached me on this subject.

It is very courteous of Government officials to receive the members of a non-technical club and to let them talk about their hobby, and very satisfactory to technical people to know that the State has no money to waste on supporting so unpractical a proposal.

The tunnel under the Thames was designed for a commonsense railway many years ago; the electrical engineer connected therewith passed away, and presumably there was no one to maintain the enthusiasm for that scheme; so it was taken over for the purpose of trying to exploit this combination.

A reference to patents will enable the writer to examine the claims.

Practical Railway Engineer.

London, *January 30th*, 1925.

Good Loud-Speaker Reproduction.

I was interested in the letter of Mr. S. J. Matthews criticising my few notes on "Good Loud-speaker Reproduction," which appeared in the ELECTRICAL REVIEW of Jan. 23rd, but do not quite see where his strictures are meant to apply, since the main body of his letter seems to me largely a confirmation of my statement that "valves should be chosen to match the particular type of l.f. transformer in use." Regarding the relative merits of resistance capacity *versus* transformer coupling, I think I have stated the case in as fair a manner as possible; with the one we have great purity of tone, with the other great volume. I am bound to say, however, that I have yet to hear the set employing more than a single stage of transformer coupling which may be described as absolutely "distortionless," and this statement is made with all due deference to the many excellent l.f. transformers now on the market. Concerning the question of valve holders: these may, of course, be of the "low-capacity" type for the high-frequency and dectector valves, though I should not personally recommend the use of the ordinary valve legs if only from the point of view of appearance. A very neat accessory is the one marketed by the H.T.C. Co., and if Mr. Matthews would inspect one of these (of the "above-panel" mounting type) he would readily be able to appreciate what I meant by advocating a holder having legs "widely spaced."

In conclusion, I should like to make the suggestion that the whole question of obtaining distortionless loud-speaker results is an extremely difficult and controversial one, upon which no two engineers seem to have the same idea; and it would be ridiculous to attempt to speak with any air of finality. That the problem has not yet been elucidated is proved by the amount of quite high-class commercial apparatus met with, in which trouble is so bad as to make anyone having the slightest ear for music turn from the loud speaker with considerable prejudice.

My brief note on the subject was not intended to advance more than a few tentative suggestions founded upon my own personal and practical experience; no attempt was made to deal with the matter in a detailed or comprehensive manner, this being, of course, quite impossible in the short space at my disposal.

London, *January 26th*, 1925. **R. Robert.**

High-pressure Cables.

I have to thank you for your very fair and reasonable criticism of my paper read last week at the Junior Institution of Engineers; but have you not slightly exaggerated the seriousness of the dielectric losses?

As given in the paper, they amount to 1.8 per cent. of the power transmitted, for 40 miles of underground cable, and for 50,000 kW transmitted; but, if the cross-section of the central core had been doubled, the dielectric losses (expressed as a percentage of the power transmitted) would have been nearly halved, the power transmitted being then doubled. Surely 1 per cent. dielectric loss on 40 miles of cable is not alarming, in view of the enormous advantages gained in the overhead line by the increased voltage?

Birmingham, *January 26th*, 1925. **A. M. Taylor.**

Visible Bonding.

At last I see somebody has written asking for visible bonding on flat metal sheathed systems.

These systems must be bonded, and every inspector of an installation must be able to see that they are bonded without having to remove ceiling roses and pattresses.

But is there a system on the market which has visible bonding? Some day, someone will wake up and put a system on the market with this property.

The lead-sheathed wiring has come to stay, for how could cables be better housed than in the lead sheath, put on in the cable maker's works? This being so, let us look to the bonding.

January 27th, 1925. **Electron.**

Generation and Distribution Costs.

I shall be pleased to know, through the medium of your paper, what are the principal factors taken into account in the working out of the generation and distribution costs of electricity. Also, if the cost per unit at the supply company's meters on the consumers' premises is the product of generation and distribution costs.

James Fitzgerald.

Tralee, Co. Kerry,
January 1st, 1925.

Synthetic Resin Mouldings.

By G. M. CARPENTER.

THE subject is dealt with in a practical manner in the following article, which is chiefly intended for those who, having used mouldings in connection with their work, *e.g.*, wireless fittings, desire further knowledge concerning them.

Synthetic Resins.

As the name implies, it relates to a material possessing resinous properties, being built up by chemical reaction. For those who require a more technical definition, the following has been evolved by Carlton Ellis, the eminent chemist, whose book "Synthetic Resins" is invaluable to students and those who are vitally interested in synthetic resin mouldings:—

"A synthetic resin is a complex amorphous organic semi-solid or solid material, usually a mixture of substances; built up by chemical reaction, and approximating the natural resins in various physical properties; namely, lustre, fracture, comparative brittleness at ordinary temperatures, insolubility in water, and fusibility or plasticity when heated or exposed to heat and pressure, but commonly deviating widely from natural resins in chemical constitution and behaviour with reagents."

Needless to say, an enormous amount of work has been performed by chemists in this sphere—even as far back as 1800, attempts to produce compounds of phenol and methylal only resulted in resinous bodies being formed.

In those days the possibilities of resinous bodies were not realised, and it was chiefly due to the fact that the supply of natural resins was diminishing that scientists turned their attention to the synthetic resin. The synthetic resin which the writer is chiefly concerned with in this article is produced by the reaction of phenol with formaldehyde.

Application of Synthetic Resin to the Moulding Trade.

The requirements in the plastic moulding field are:—

(*a*) A material which will soften under the influence of heat, and which can be pressed into suitable steel dies, further heat rendering the material hard and enabling the piece to be ejected from the mould.

(*b*) A material which is strong mechanically, and in a number of cases must possess high dielectric strength.

(*c*) The material must retain its finish indefinitely, not be affected by acid or alkalis, non-inflammable and non-hygroscopic, &c.

The above gives the general requirements of the trade. Synthetic resins find a wide use in the moulding trade, because when they are incorporated with a suitable "filler," we obtain some, if not all, of the requirements stated above.

The fillers in general use are wood-flour, asbestos, cotton-flock, &c. They are incorporated with the resin in a mixing machine, which comprises heated steel rolls revolving towards each other. The initial resin melts on the rolls, and at this stage the colouring matter and filler are added.

Finally, when thoroughly mixed, the compound is allowed to cool, and then ground to a powder, which is then ready for use. There are cases, however, where the moulding composition is required in sheet form. When this is so, the compound is delivered from the mixer to a special machine, having water-cooled rollers, through which it is passed, thus taking a definite width and thickness.

Moulding Procedure.

The moulding composition of the infusible type which the writer is considering, goes through the following changes before reaching the finished product.

At a mould temperature of about 150 deg. F. the composition commences to soften. During this plastic stage, the powder will "flow" in the mould provided sufficient pressure is applied. Further application of heat completes the chemical reaction and the composition changes to an infusible product. When cooled sufficiently the moulded piece is ready for ejection.

The following operations are therefore necessary:—

(*a*) Mould pre-heated to about 150 deg. F.
(*b*) Mould separated, cleaned, and inserts placed in position.
(*c*) Correct weight of powder introduced into mould.
(*d*) Mould placed in heated hydraulic press—heat and pressure applied simultaneously.
(*e*) Mould finally closed under pressure—heating continued until "curing" is complete.
(*f*) Mould is then cooled—20/40 deg. F. is usually sufficient.
(*g*) Moulding ejected.

It will be evident that the above procedure is rather lengthy, and is reflected in the cost of the moulded article. To reduce the cost, however, multi-impression moulds are used whenever practicable.

It will not be out of order to describe the above operations more fully.

(*a*) Better mouldings are produced when the powder is introduced into a warm mould. If powder is charged into a cold mould, care must be exercised to see that no appreciable pressure is applied which would damage the mould, or break insert anchoring pins, until the powder has reached the plastic stage, *i.e.*, about 150 deg. F.

(*b*) Prior to introducing the charge it is absolutely essential to have the mould clean. Small pieces of swarf, which have a tendency to cling to inserts after the machine operations, must be removed. Directing a jet of compressed air into the cavity of the mould usually suffices.

(*c*) Theoretically, there is only one correct weight for a given moulded piece. If less weight is introduced, the moulding will show a blemish due to a lack of pressure on one portion of the moulding. Too much weight will increase the "flash" and necessitate more time being spent on removing it in the "frazing shop." Weights correct to ½ gramme are usual.

(*d*) The pressing operation is very important. Not only must the correct pressure be used, it must be applied when the powder is in the plastic form. Good results are obtained by using a low pressure for the commencement, about 1,000 lb. per sq. in. of projected moulded area, and when the mould is practically closed, increasing the pressure to 2,500 lb. per sq. in.

(*e*) The time of duration for the curing period can only be determined by experiment. It depends upon:—

1.—The heat of the press platens.
2.—The thickness of the mould wall, *i.e.*, between the mould cavity and the platen.
3.—The thickness of the moulded piece.

A proper cure for a definite moulded piece at, say, a mould temperature of 230 deg. F. would probably necessitate 10 minutes or more in the press, whereas if the temperature were increased to 275 deg. F. the time would most probably be halved. A temperature of 300 deg. F. would mean a still quicker "cure," but temperatures above this are to be deprecated, as they necessitate forced cooling of the mould before re-charging.

(*f*) It is generally advisable to cool the mould slightly before opening to eject. A better finish is obtained by doing this, and also the interior of the mould does not run too hot, thus avoiding the possibility of the subsequent charge having a limited flow.

On the other hand, excessive cooling, *i.e.*, dropping the temperature more than, say, 30 deg. F. will probably crack the moulding due to contraction. The maximum

output of any mould is obtained when the heating and cooling times are a minimum. This can only be achieved by having a small temperature gradient throughout the mould.

(*g*) Proper tools must be available in order to eject the finished moulding from the mould in a scientific manner. Forcing the moulding out by the use of hand tools is very crude and should not be tolerated in any moulding shop. The ejectors must exert an equal pressure on the moulding, thus allowing it to leave the mould evenly. Tapping during ejection will result in cracked mouldings.

Difficulties Experienced in Moulding.

There are several problems which moulders are up against from time to time—among these may be mentioned:—

(*a*) Staining.
(*b*) Sticking.
(*c*) Air-locks.
(*d*) Mould not filling up properly.
(*e*) Blistering.

(*a*) *Staining.*—Continuous use of the mould occasionally results in the mould surface becoming dull. This means that subsequent mouldings will have a dull finish and is detrimental from several points of view.

In the first place, the selling value of the article is reduced. Secondly, in cases where the moulded article is used in electrical work, a dull surface materially assists surface leakage, especially if high voltages are employed.

The writer has known of cases where mould staining has been intensified by the repeated opening of the mould before the cure was finally complete.

(*b*) *Sticking.*—This means, that when the moulded piece is ready for ejection, part of the moulding breaks away and remains in the mould. This may be due to one or more of the following reasons:—

1.—Inserts tight on anchoring pins.
2.—Mould temperature too hot for ejecting, thereby not allowing the moulding to contract sufficiently to enable it to leave the mould cleanly.
3.—Cooling of the mould carried too far, causing excessive contraction of the moulding on to the pins.
4.—Defect in the mould, such as undercut, &c.

(*c*) *Air-locks.*—During the moulding period the air must be allowed to escape as the mould closes. If the mould is closed too rapidly a film of changed powder may form around the side and effectually seal the mould, thus entrapping the air. The finished moulding in such a case has the appearance of being a "short-charge"—a definition which all moulders will understand.

In cases where a mould has been incorrectly designed, or is of a difficult nature to work because of the formation of air-locks, good results can sometimes be obtained by turning the mould upside-down for the pressing operation.

(*d*) *Mould not filling up properly.*—This may be due to one or more of the following reasons:—

1.—Filling in too hot, thus causing the moulding compound to change before the mould can be placed under pressure. If this is the case, a thick "flash" is the result.
2.—Using insufficient pressure. With positive plunger type moulds this is rarely the cause. It applies chiefly to multi-impression moulds where the impressions are joined together by a flash.
3.—If the flash is very thin it generally points to a short charge.

(*e*) *Blistering.*—This is generally caused by using a higher platen temperature than is necessary. With continuous running, say, on a five-hour shift, the mould core tends to get too hot, with the consequent possibility of "blistering" occurring. Chilling the cavity of the mould before filling with a fresh charge will get over the trouble. Another reason, however, may be the fact that the mould is opened before the cure is finally complete and, as reaction is still taking place, an uneven surface on the moulding ensues.

A Note on Moulds.

Owing to the large pressures required in the production of synthetic resin mouldings, the moulds must be very strong and fully capable of standing up to the service required of them.

A small mould will cost anything from £25 to £75, whilst some of the larger ones, as used in the States, easily run into the hundreds figure. The high cost is chiefly due to the enormous amount of intricate work entailed and the high finish required. Multi-impression moulds are high in initial cost—there is, however, a saving on each piece.

Single impression moulds are relatively cheap in initial cost—but the price per piece is high. For this reason single-impression moulds only find use in experimental work, and in cases where the quantities required would not justify the cost of a multi-impression mould.

It is strongly advisable to use hardened steel moulds. They have a long life and retain their polish. For experimental work unhardened steel moulds are preferable as they allow of alterations to be easily made.

..., however, the design has proved efficient it pays to have the mould hardened.

Earlier in this article, attention was drawn to the possibility of the mould staining after long use. In this connection it will not be out of place to mention that good results have been obtained by the use of stainless steel for the mould core.

In designing moulds there are several considerations to be taken into account. The ratio of volume of mould to volume of moulded piece should be as small as possible, consistent with the mechanical strength of the mould. Increasing this ratio increases the heating and cooling times, and consequently decreases the output of the mould.

So far as is possible, the designer should eliminate all sharp corners and modify the design until neat curves are obtained. It must not be forgotten that the moulding composition "flows" and if the mould is designed to assist this flow, as the top half of the mould closes, a better finish is obtained on the moulded piece.

Insert anchoring pins should be sufficiently strong to withstand the shearing stresses set up in the mould by this "flow." The moulds should possess as few movable parts as possible—the mould is handled at an uncomfortably high temperature, and the fewer the parts that require handling, the higher the mould output.

It is much cheaper, as well as more practical, to have figures and lettering raised in the moulded article rather than sunken. This is obvious for several reasons. In designing moulds for very accurate work it is necessary to take the shrinkage of the moulding into account. This shrinkage varies with the actual moulding composition used—the usual figure is about .003 to .005 per lineal inch.

Plant Layout.

The actual form which the layout takes, for the production of synthetic resin mouldings, depends upon the size of the work in the first place.

Small work, allowing the employment of small moulds, would only need relatively small presses. It is advisable to adopt two sizes of moulds as standard dimensions, and arrange the number of impressions in each to allow of a uniform pressure being required. By doing this, uniformity is attained, and considerably assists in running the shop on scientific lines.

Whatever system of heating the presses is used, whether steam, electricity, or gas, a definite method of determining the mould temperature seems advisable. A wide variation in curing times can result if left to the operator's sense of "touch" although the writer knows of one plant which is being run on these lines.

The cold press to receive the mould for ejecting should be fairly close to the heating press, thus reducing mould handling times. The efficient moulder sees that he has

all the tools he requires in readiness, so that as soon as a mould is ready for ejecting, no time is lost at the critical moment.

It will be evident to those who have read this article carefully that there is a definite waiting time, or period, in each cycle of operations, *i.e.*, the heating time. The problem of how to occupy the moulder's time during these periods demands careful thought, if cost is to be a minimum. The simplest way is to run, say, two moulds whose operation times are more or less identical, and so double the production.

The writer does not favour the system whereby several operators handle the same mould. Each mould has peculiarities of its own which calls for special treatment, and when the mould is handled by one operator only, less scrap is made due to the fact that the operator has acquired the " knack " of handling that particular mould to obtain best results. It is very noticeable that where a mould is handled by two or more operators, the percentage of scrap is higher.

One operator can handle two or three moulds efficiently, provided the complete handling times of two moulds are equal to the curing and cooling time of the other mould.

Conclusion.

The writer has not attempted to delve into every detail connected with this subject; to do so would require many volumes, and considerably more experience than the writer possesses. Such indeed, was not the idea when penning this article. It was felt that there were many individuals who would welcome an article such as this, dealing as it does in a practical manner with such an interesting subject as synthetic resin mouldings.

Legal.

False Pretences Charge.

At the Old Street Police Court, on January 27th, Albert Weale, a traveller, was charged with endeavouring to obtain money by false pretences, and with having in his possession goods bearing a false trade description. Defendant was alleged to have offered as " Tungstalite " radio crystals not produced by Tungstalite, Ltd., the proprietors of the trade mark. He stated that he was merely travelling for his brother, and knew nothing about the goods which he received to sell. Defendant was remanded to enable him to call his brother as a witness.

British Thomson-Houston Co., Ltd., v. British Insulated and Helsby Cables, Ltd., and v. Charlesworth, Peebles and Co.

The judgment in the appeals made respectively by the plaintiffs in the first-mentioned case and the defendants in the other against judgments given against them in the lower Courts, was delivered in the House of Lords on February 3rd.

In the result, the patent owned by the British Thomson-Houston Co., Ltd., in respect of the production of tungsten filaments has been declared invalid, and final judgment, with costs, has been awarded against the company.

Lord Haldane, in pronouncing his decision, said, briefly, that he had come to the conclusion that the production of tungsten ductile, when cold, was more the result of advances in the metal worker's art than of any discovery.

Lord Dunedin said that he concurred, but regretfully, for he could not help feeling that a real inventor had lost the fruit of his invention.

Lords Shaw, Buckmaster, and Blanesburgh also agreed with Lord Haldane's judgment, a full report of which will appear in our next issue.

Electro-Mechanical Brake Co., Ltd., v. Rheostatic Co., Ltd.

In the Court of Appeal, on January 27th and 28th, before the Master of the Rolls, Lord Justice Sargant and Mr. Justice Astbury, the plaintiffs in this case appealed against a judgment of Mr. Justice Eve in the Chancery Division.

The proceedings in the Chancery Court were reported in our issues of July 18th (pp. 109 and 123) and 25th (p. 137), 1924. The plaintiffs alleged that the defendants had infringed a patent owned by them covering the manufacture of a jointless tramway resistance, and asked for a restraining injunction. The defendants denied infringement, and pleaded that the patent had been anticipated and was invalid for want of subject matter. Plaintiffs' resistance comprised a continuous metal grid, whereas, it was stated, continuity was obtained in the defendants' resistance by spot welding. Mr. Justice Eve held that the defendants succeeded in their defence of non-infringement, but failed in their other pleadings, and judgment and costs were awarded accordingly. The plaintiffs appealed from the first part of the judgment, and the defendants entered a cross-appeal against the latter part.

Mr. Trevor Watson, for the appellants, reviewed the case presented in the lower Court, and said that the patent was taken out in 1909. It expired during the current year, and up to the time of the action it had never been challenged. The respondents claimed that by their system of welding the grids they obtained an electrical continuity which had not previously been obtained, whereas there had always been electrical continuity in appellants' grid.

Mr. Hunter Gray, K.C., for the respondents, supported the judgment of Mr. Justice Eve on the issue of infringement, but reserved his rights in the event of a further appeal.

In giving judgment, the Master of the Rolls said that the respondents, in securing continuity by welding had not adopted the method protected by the appellants' patent. He considered that Mr. Justice Eve was right in holding that there had been no infringement, and the appeal would therefore be dismissed.

Lord Justice Sargant and Mr. Justice Astbury concurred.

Weber v. Birkett.

Sitting in the King's Bench Division on January 29th and 30th, the Lord Chief Justice and a special jury heard an action by Major W. V. Weber, a member of the Southend-on-Sea Corporation and the Borough Electricity Committee, against Mr. Robert Birkett, the Southend Borough Electrical Engineer and Tramways Manager, in which the plaintiff claimed damages for libel and slander. Appearing for the plaintiff, Mr. Ernest Charles, K.C., said the Southend Corporation decided, acting upon Mr. Birkett's advice, to install in its Leigh-on-Sea sub-station, a number of Diesel oil engines for the purpose of generating electricity. Major Weber, who was an engineer, was of opinion, with other members of the Council, that the engines were not satisfactory, particularly as they were of German origin. Unfortunately, Mr. Birkett made the opposition a personal matter and at a public gathering held at Leigh-on-Sea when one of the engines was inaugurated and members of the Town Council were present, Mr. Birkett made a long speech in which he accused Major Weber of assisting busybodies to publish nefarious propaganda in opposition to the scheme, of being guilty of " Jekyll and Hyde " methods in his work as a Councillor, of obtaining preferential treatment because of his connection with the Electricity Committee, and of trying military methods to control the staff. In addition, he had libelled the plaintiff by publishing the speech in the local newspapers. No evidence was called for the defence, it being stated that Mr. Birkett had made an ample apology in the public Press and paid a sum into Court as damages. In fact, said Sir Henry Maddocks, K.C. (for the defendant), Mr. Birkett had done all that was possible to restore to Major Weber any prestige he might have lost by the alleged slander. In his summing up the Lord Chief Justice said that Mr. Birkett's speech did not consist of phrases made on the spur of the moment but was a well-thought-out and lengthy set of observations into which were woven deliberate attacks upon Major Weber. So deliberate was he that he gave the editor of a local newspaper a copy of the speech the day before he delivered it. In the circumstances the libel seemed to be a malicious one. The jury awarded Major Weber £200 damages and as that sum was less than the total amount paid into Court by the defendant, his Lordship said he would consider as to which party should have the costs of the action.

Flashing in Air-electric Discharge Tubes.—A paper describing a study of the production of " flashing " in air electric discharge tubes by Messrs. James Taylor, B.Sc., and William Clarkson, B.Sc., Armstrong College, Newcastle-upon-Tyne, was read before the Physical Society of London recently by Dr. D. Owen in the absence of the authors. It deals with an extension of the study of "flashing" in discharge tubes, first observed by Pearson and Anson in the case of the " Osglim " lamp, containing air instead of the usual mixture of neon and helium. The volt-ampere characteristics for the air discharge tubes are shown to be of the general form : $i = k(V-M)$, where i is the current through the tube, k the conductance of the tube, V the voltage across the electrodes, and M a constant, theoretically of the value of the cathode fall of potential V_A.

$$T = CR \cdot \log_e \frac{E - V_B}{E - V_C} + C\Delta \cdot \log_e \frac{V_C - V_A}{V_B - V_A}$$

where C is the capacity in microfarads across the tube, R is the resistance in megohms, in series with the tube, E, V_C, V_B the charging, upper critical, and lower critical voltages respectively, and Δ, a constant. This relation is generally confirmed by experiment. It is shown that, as in the case of the " Osglim " lamp, there is a critical resistance R_c below which no " flashing " is possible, given by

$$R_c = \frac{E - V_B}{k(V_B - V_A)}.$$

Wireless Measurements during the Solar Eclipse.

DURING the solar eclipse of Saturday, January 24th, 1925, certain measurements of the intensity and apparent bearings of wireless signals were carried out in this country by members of the staffs of the Engineering Department of the General Post Office, the Radio Research Board of the Scientific and Industrial Research Department, and the International Western Electric Company, Incorporated. The American Telephone and Telegraph Company, in co-operation with the Radio Corporation of America, transmitted special signals from an experimental station situated at Rocky Point, Long Island, U.S.A. Special transmissions were also made by the Leafield and Northolt stations in this country. In addition to those made on January 24th, observations were carried out on the day preceding and the day following the eclipse for the purpose of obtaining comparative data.

The following brief notes, with a graphical representation of the results obtained, are given here pending a more complete discussion. Fig. 1 shows the signal intensity of Rocky Point measured at Aberdeen on a frame coil, on January 24th and 25th. Fig. 2 shows the signal intensity of the same transmitter (2 X S, 57 kc) as observed at Chedzoy, Somerset, on a wave antenna; the results obtained on a frame coil were very similar. Fig. 3 is a copy of a gnomonic chart showing the path of the total eclipse across the Atlantic, with the times of the centre of the total phase; the totality varying in duration along the path from 1m. 42s. to 2m. 32s. From first to last contact the eclipse lasted for about two and a half hours along this path. The great circles from the transmitting station at Long Island to the receiving stations in England are also shown in fig. 3.

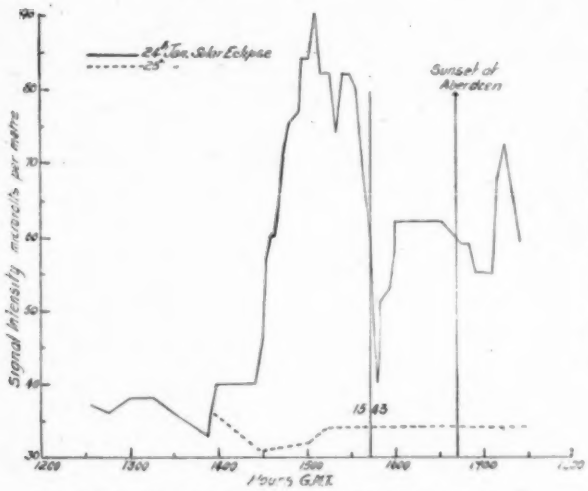


Fig. 1.—Signal Intensity of Rocky Point Observed at Aberdeen.

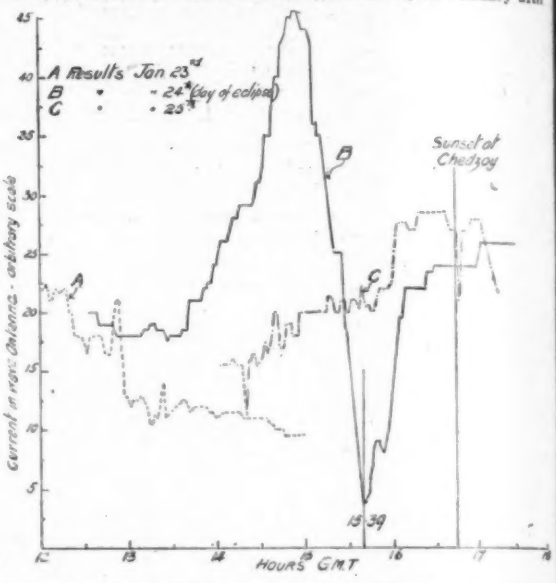


Fig. 2. Signal Intensity of Rocky Point Observed at Chedzoy.

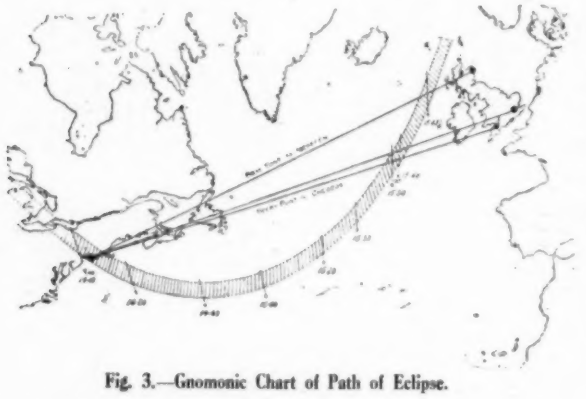


Fig. 3.—Gnomonic Chart of Path of Eclipse.

The rise in signal intensity to a very sharp maximum followed by a well defined minimum on the day of the eclipse only is very well marked in figs. 1 and 2.

The rise in each case corresponds approximately to the intersection of the path of the beginning of the eclipse with the great circle between transmitter and receiver; while the minimum of signal intensity coincides to within one or two minutes with the intersection of the path of totality and the corresponding great-circle (see fig. 3).

Fig. 4 shows the wireless bearings of Rocky Point observed at Slough on January 24th and 25th. These bearings were very steady in each case, the maximum departure from the mean bearing being 1 deg. .3; and there is seen to be no detectable effect due to the eclipse.

Additional observations were carried out at Slough on the signal intensity and bearings of Leafield (GBL, 24 kc) and the results for January 23rd and 24th are shown in fig. 5. For this short range of transmission (48 miles overland) the erratic behaviour of both factors is very marked, but no effect is traceable to the eclipse, since these variations are a normal daily occurrence at this period of the year.

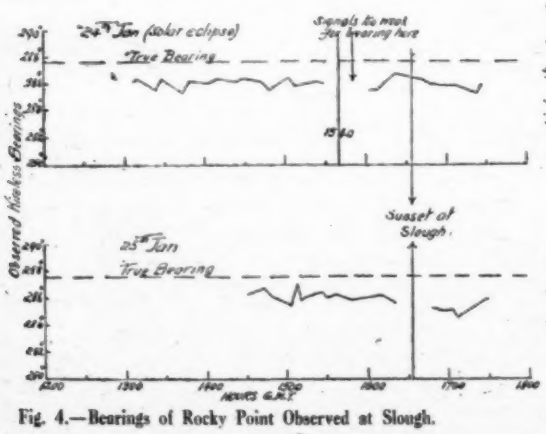


Fig. 4.—Bearings of Rocky Point Observed at Slough.

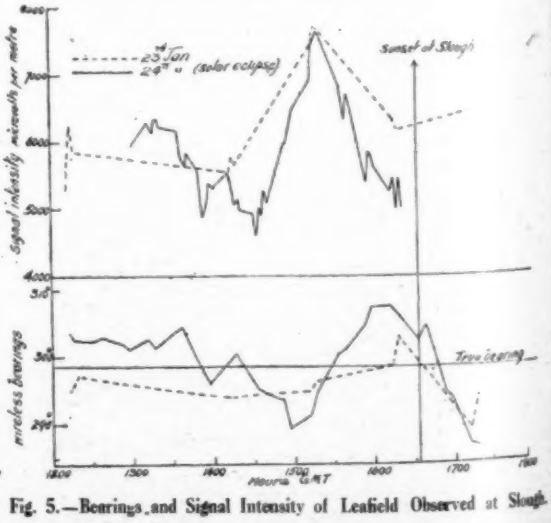


Fig. 5.—Bearings and Signal Intensity of Leafield Observed at Slough.

Business Notes.

ankruptcy Proceedings.—LEONARD SPREADBOROUGH, 539, h Road, Leytonstone, electrical engineer.—The public mination of this debtor was held on January 27th, at the don Bankruptcy Court, the accounts showing unsecured s £366, fully secured debts £400, and assets £4. Replying Mr. V. Armstrong, Official Receiver, the debtor stated that commenced business in 1902 with £5 capital, and six years r he paid a composition of 5s. in the £ on liabilities of nt £200. He continued the business at various addresses November, 1923, when he was again in financial difficulties; creditors then refused to accept 5s. in the £, and he ed trading, but his wife carried on business as a dealer radio accessories. Witness attributed his failure to the ing away of trade, working under cost, and lack of profits meet his drawings. The examination was concluded. The following are creditors :—

	£		£
...ield, C. O.	34	Stella Lamp Co., Ltd.	35
..., Ltd.	182	Fully secured	400
...ridge Cable Co., Ltd. ...	23		

EMUEL SHULMAN, 103, New Road, Whitechapel, E., electal engineer.—The debtor was brought to the London Bankcy Court in October, 1924, upon the petition of the British mson-Houston Co., Ltd., which claimed £472, and was only creditor. He attended on January 27th before Mr. gistrar Mellor, and in the course of his public examination, ted that he was an unnaturalised Russian, and he comced to trade in electric lamps and accessories in Septem-, 1922, without any capital. An action was brought against by the petitioning company for an injunction restraining from infringing its patents. He consented to judgment, d paid the costs of the action, but in March, 1924, he was ceeded against for damages in relation to the action; judgnt was given against him for £150 damages and costs, and se bankruptcy proceedings followed. Witness had no assets. e examination was concluded.

RNEST BRADLEY, trading as Bradley & Co., 16, Widemarsh eet, Hereford, electrical engineer.—The public examination this debtor was held on January 26th, at Hereford. The tement of affairs showed liabilities of £896, of which £841 s expected to rank, against assets of £178, leaving a defiency of £663. Debtor attributed his failure to losses on ntracts and to illness in his family. He commenced busis in June, 1922, and prior to that date he was an employé rning from £4 10s. to £5 a week, and he had saved £50. In ril last he entered into a contract to install an electric hting plant for £826. This work was completed, but £135 s sent direct through the architects to a firm which supd special fittings detailed in the contract. £96 was still under the contract. There was an offer made of a comition of 15s. in the £ in November, but it was not accepted. e examination was adjourned.

. F. GUEST (L. D. & J. Guest and Guest & Robinson), mber, electrician, &c., 97, Great Horton Road, and Barker-d Road, Bradford.—First and final dividend of 18s. in the payable February 9th, at 17, Piccadilly, Bradford.

. E. MARTIN, electrical engineer, 104, Oldham Road, Manester.—Receiving order made January 24th, on debtor's own tition.

. C. PERRY, building and electrical contractor, Birchfield ad, Headley Cross, Redditch.—Last day for proofs for divind February 11th. Trustee, Mr. T. Easton, Official Reiver, 191, Corporation Street, Birmingham.

Company Liquidations.—SEAELL ELECTRIC CO., LTD.—Windg up voluntarily. Liquidator, Mr. R. Kendall, Park Square ambers, Leeds.

PREMIER ELECTRICAL WELDING CO. (SWANSEA), LTD.—Windg up voluntarily. Liquidator, Mr. E. H. Discombe, Harw, Manorway, Abbey Wood, S.E.

WHEELERS ELECTRIC SHADE CARRIER, LTD.—A meeting of embers is called for March 2nd at Lloyds Bank Buildings, ng Street, Manchester, to hear an account of the winding from the Liquidator, Mr. V. Walker.

CONNOLLY BROS., LTD. (old company).—Second and final vidend of 4s. 1½d. in the £, payable February 10th, at Moorgate Buildings, E.C.

NORWOOD WHOLESALE FITTINGS SUPPLY CO., LTD.—Winding order made by the High Court on January 27th.

ASDIC WIRELESS & SCIENTIFIC INSTRUMENTS, LTD.—Last day r proofs for dividend February 16th. Liquidator, Mr. G. D. ipps, Official Receiver and Liquidator, Carey Street, W.C.

Dissolution of Partnership.—NORTHERN SUPPLY CO., elecal engineers, 28, Victoria Square, Bolton.—Mr. R. Hampn and Mr. A. Mearns have dissolved partnership. Mr. earns will attend to debts and continue the business under e same style.

Trade Announcements.—MESSRS. BARNETT & SOANS have ened a further branch at High Street, Prestatyn, North ales, and desire to receive catalogues, &c.

MESSRS. A. J. WELLS & Co. have removed from 13, Stanley reet, to 52, Princess Street, Luton.

MR. W. A. TAYLOR, electrical engineer and contractor, has moved his business to new premises at 74, Apley Road, ncaster, where he is stocking radio equipment as well as ectrical supplies.

MESSRS. JOHNSON & PHILLIPS, LTD., have installed an addinal telephone at their City office. The number is London all 2411.

WALTER BAMFORD, electrical and radio wholesale factor, has transferred his offices and stores to 116, Steelhouse Lane, Birmingham. Telephone No.: Central 6308.

Catalogues and Lists.—THE BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, W.C.2.—Publication R.7392, illustrating and describing a combined table lamp and loud speaker.

ELECTRIC SUCTION CLEANER CO., Victory Works, Gloucester Road, Croydon.—Folder giving prices and particulars of the "Croydon" electric suction cleaner.

HOWDEN-LJUNGSTROM PREHEATERS (LAND), LTD., 133, Helen Street, Govan, Glasgow.—Illustrated pamphlets, dealing with the construction and installation of "Howden-Ljungstrom" air preheaters for boiler installations.

RADIO INSTRUMENTS, LTD., 12, Hyde Street, New Oxford Street, W.C.1.—A showcard advertising "R.I." radio transformers, bearing a cardboard "cut-out" of a l.f. pattern.

TOK SWITCHES, LTD., Granville House, Arundel Street, W.C.2.—An illustrated catalogue of rotary snap switches and interlocking switch-plugs.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—Leaflet X.3544, describing the company's "D.B." quick-make-and-break switch, and Leaflet No. F.3256, dealing with the "Equipoise" bracket fitting for hospitals. Illustrated.

THE WESTMINSTER ENGINEERING CO., LTD., Victoria Road, Willesden Junction, N.W.10.—An illustrated pamphlet advertising the "Westminster" commutator grinder.

SIEMENS & ENGLISH ELECTRIC LAMP CO., LTD., 38 & 39, Upper Thames Street, E.C.4.—February price list of electrical supplies.

THE STONEBRIDGE ELECTRICAL CO., LTD., Victoria Road, North Acton, W.3.—Two illustrated mailing cards advertising the company's electrical instruments.

MESSRS. L. MCMICHAEL, LTD., Hastings House, Norfolk Street, Strand, W.C.2.—Monthly sales letter and an illustrated and priced pamphlet dealing with condensers and h.f. transformers.

Office of Works Employés' Strike.—About a thousand men employed by the Office of Works at a number of public buildings struck work on January 27th. The strikers included a great number of electricians, and a number of services, including lifts and heating, were discontinued. The strike was due to the employment by the Department of a member of the E.T.U., whose subscriptions were in arrear.

Continued negotiations between Lord Peel and the men's representatives took place last week, but it was not until Tuesday morning last that it was announced that a settlement had been made. It was then stated that the member of the E.T.U. about whom the strike occurred had agreed to make good his arrears by instalments.

For Sale.—Bexley Urban District Council Electricity Department invites offers for the purchase of the power station buildings situate at Bexley and the plant consisting of three Lancashire and one Stirling boilers, three 225-b.h.p. Browett-Lindley engines, one 500-kW Westinghouse turbine complete, dynamos, alternators, forced draught plant, &c. Salford Corporation Electricity Department invites offers for one 5,000-kW turbo-alternator, with condenser plant, &c., eight Lancashire boilers, Green's economisers, &c. (See our advertisement pages to-day.)

Social Events.—The sixth annual dinner of the directors and staff of Messrs. Ernest F. Moy, Ltd., was held on January 17th. Mr. E. F. Moy presided, and was supported by his fellow directors, the Mayor of St. Pancras, Mr. Baker (London Electric Railway), and others. Mr. H. A. Lamb proposed the toast of "The Firm" in an appreciative speech, and Mr. Moy replied, and presented a number of cricket prizes. Councillor Dykes responded for the recipients, and the Mayor, Major Barker, and Mr. Baker also spoke.

Mr. H. J. Balchin presided over the fifth annual dinner of the Gloucester Branch and Sports Club of the Bristol Tramways & Carriage Co., Ltd. The guests included the Mayor of Gloucester (Mr. F. W. Duart Smith), Col. S. E. Smith (general manager), and other officers of the company. Dr. W. Arnott Dickson proposed the toast of the "Bristol Tramways & Carriage Co., Ltd.," to which Col. S. E. Smith made reply. Other toasts included "The Mayor and Corporation of Gloucester" and "The Gloucester Chamber of Trade."

Swedish Exports.—The expansion in exports from Sweden is shown by the fact that the exports of electrical machinery in 1924 increased by 282 per cent. in value over those in 1913, considered in Swedish kronen. During the same period the value of the exports of ball bearings has grown by 342 per cent., and that of exported telephone apparatus by 31 per cent.

According to statements made in Stockholm by Mr. J. S. Edstrom, director of the Allmanna Svenska Elektriska Aktiebolaget, the company now has foreign orders on hand for a total of 10,000,000 kr., of which 6,000,000 kr. represent contracts with Russia and Finland. The Finnish orders concern the new power station at the Imatra Falls for the electrification of the south of the country, the Russian orders apply to a large station in the neighbourhood of Leningrad, and a third order applies to the complete delivery of generators, transformers, &c., for a large power

station in New Zealand for about 2,000,000 kr. In this connection it is mentioned that the company has just completed the establishment of an installation in the Southern Congo for a Belgian cement company, which is the first of its kind in that region.

Chinese Notes.—The Canton Electric Power Co., which recently paid $200,000 to the Canton officials for the redemption of the Government shares, has now become a purely private concern.

A branch telephone exchange, to be known as the South Branch Exchange, will shortly be opened at San Li Ho, outside Hatamen, Peking.

The Peking Tramway Co., Ltd., inaugurated its first service on December 17th last, and regular services were to be run as from January 1st on the whole of the system, comprising some 30 miles of track.

Reparations and British Industry.—Mr. Walter Leaf devoted a considerable part of his speech at the annual meeting of the Westminster Bank, Ltd., to the Dawes Report and its effects. He said the security for the loan to Germany was of the highest class, and the various mortgages on the railways, industry, and revenues of Germany were such as to ensure that the taxation of the German would not be less than that of the chief allied nations. Germany was accorded, before payments in cash were to be made, a moratorium of two years to give her time to put her economic system into order—none too long after the complete collapse which had overtaken it.

For the first two years it would seem that our own industry had nothing very serious to fear from German competition. It was true that Germany had provided herself, during the collapse of the mark, with a fine equipment for production; it was true also that wages in Germany for skilled workers were very low compared with those at home, even in those of our industries which were exposed to international competition. On the other hand, it must be remembered that, owing to the annihilation of working capital, it was with great difficulty that the cash to provide even these modest wages could be found; industries of the highest standing had to pay such rates as 12 per cent. per annum and upwards for loans, and this rate of interest formed a very serious charge upon the cost of production. It was not to be supposed that the German workman would long consent to work for wages which were no more than half what were being paid on this side of the Channel. The manufacturer had to import a far larger proportion of his raw material from abroad than was the case before the war. His resources, alike in coal and iron ore, had been very seriously reduced by the Treaty of Versailles; this extended to the partly-worked commodities which were the raw materials of further industry.

But when the two years of recuperation had given way to the unlimited years of reparation, how would we stand? The creditor nations had at length accepted, though reluctantly, the undeniable truth that payment could be received only in the form of goods; and how the enormous excess of exports which we were forcing upon Germany was to be absorbed by the world at large without a ruinous competition with our own export trade was a problem which was now exercising the best brains of Europe and America.

He could not say what the solution was likely to be, but an earnest attempt was being made to find it by common agreement between the nations of the world.

Postponement of Belgian Electrical Exhibition.—The proposed International Electrical Exhibition, which was to have been held in Brussels during the current year has been postponed until 1930, when it will coincide with the centenary of Belgian independence.

Wages in the Engineering Industry.—Mr. Austin Hopkinson, M.P., recently stated, according to *The Times*, that the discontent among employés in the engineering industry and the consequent poor output were due to the comparatively low wage paid to them. At his own works the wages paid were practically double the standard hourly rate, yet he undersold his competitors with the greatest of ease and received a large return on his capital. To raise the wages in the engineering industry by even so little as 10s. per week was to take a very grave risk, but he was convinced that to leave them at the present level was to consign the industry to a living death.

Supplies for a Chilean Railway.—The Commercial Secretary at Santiago, Chile (Mr. W. F. Vaughan Scott), has forwarded to the Department of Overseas Trade a copy of the local *Diario Oficial* containing a Decree inviting public tenders, to be presented in Santiago by February 27th, for the supply of miscellaneous materials for the Arica-La Paz Railway. The articles required include steel bars and sheets, copper, steel and galvanised wire, wire for electric welding, copper and black and galvanised iron piping; bronze and copper in bars, sheets and ingots; iron in bars and in black and galvanised sheets; cotton and wool waste, asbestos packing; nuts, bolts, rivets, &c.; metallurgical and forge coke, foundry earths; miscellaneous tools, rail spikes, calcium carbide, tin in ingots, &c. A copy of the *Diario Oficial* (in Spanish), giving further particulars of this call for tenders may be consulted by interested British firms on application at the Department, 35, Old Queen Street, S.W.1.

Finnish Customs Tariff.—The *Board of Trade Journal* publishes a list of articles showing the import duty placed upon them by the Finnish Government. The rates given are "conventional," and in some cases a percentage reduction applicable to goods of French and British origin. Among rates given are the following:—Electrical machines (ge ators, motors, converters, transformers, &c.), each weigh not more than 500 kg. net (*a*) of types not made in Fin 3 F mk. per kg., (*b*) of types made in Finland 7 F mk. kg.; galvanic batteries 2.5 mk. per kg.; electro-tech special apparatus and parts n.e.s. 12 mk. per kg.; and ins tors weighing up to 4 kg. each, conduits and other arti for insulating electric wires 4 mk. per kg.

Developments in Colombia.—A correspondent of *Financial Times* reports that construction work on the Cen Bolivar Railway (Colombia) has commenced; this railway develop the Province of Bolivar, of which Cartagena is capital. In addition the Standard Oil Company is to e refineries in the city; the Dique Canal, between Cartag and the Magdalena River is being dredged; the water sup is being improved; and the electricity works is to be compl early this year. These developments will make Cartage one of the principal cities in South America.

Threatened Strike of Metropolitan Railway Electrician —On January 29th the Electrical Trades Union tendered se days' notice of the intention of 300 members employed the Metropolitan Railway Co. to cease work. It appears th the Union, in July last, asked the company to consider increase in the wages of men in two grades employed them—wiremen and power-house fitters. The company co tended that it was already paying the maximum rates l down by the Industrial Court, and no action was taken. T company has expressed its willingness to submit the questi to the Industrial Court, but will not make the concessi demanded, but the E.T.U. has refused this offer.

Only about 30 men are directly concerned in the matt but a strike would involve all the E.T.U. members emplo in the company's power stations, and lighting and cable partment.

In the early part of this week the company announced th it would be able to carry on its services without inconvenie to the public, but the Union replied that the employment "blackleg" labour would lead to a serious extension of t strike.

The strike was eventually averted by the company's agr ing to concede an increase in wages to the thirty men co cerned.

Book Notices.—Scientific Papers of the Institute of Ph sical and Chemical Research. No. 12, "Spectra of Constric Arc of Metals," and No. 13, "The Fine Structure of Mercu Lines and the Isotopes." Tokio: Iwanami Shoten. Pr 2 yen.

"The *Mechanical World* Electrical Pocket Book, 192 (Pp. 387; 136 figs.). London: Emmott & Co., Ltd. Pr 1s. 6d. net.—Several new articles appear in this edition, amo them being one on primary cells. A long section on the lat methods of testing generators, motors, and transformers added. Another new feature is a section on electricity supp systems, comparing these for various applications and givi notes on the conversion of a.c. to d.c. X-rays, and electri battery vehicles are also added to the subjects dealt wi in the publication. Readers may be pardoned for thinki that some of these additions are overdue, although it must realised that it is most difficult (perhaps impossible) to surv electricity and electrical applications from A to Z in a pock book.

"The Strength of Rotating Disks," by R. Gardner. P 56; 14 figs. London: Association of Engineering and Sh building Draughtsmen. Price 2s. net.—This pamphlet h been compiled with special reference to steam turbines, a the general case is worked out in some detail. Nothing beyo a fairly elementary knowledge of differential equations needed to follow the mathematical theory, but the auth finds it difficult to answer the question: Cannot the stres be found by some graphical step by step method like tho in an irregularly-loaded beam?

"The Japanese Journal of Physics," Vol. III, Nos. 1-3. (P 6+73; 17 plates.) Tokio: National Research Council of Japa —This volume contains a number of papers and abstrac upon electro-physical and other matters.

"Junior Technical Electricity," by R. W. Hutchinson. P viii+382; figs. 327. London: University Tutorial Press, Lt Price 4s. 6d.

"Science Abstracts." (A. and B.) Vol. XXVIII. Part January 25th, 1925, and Index to Vol. XXVII. (A. and B. London: E. & F. N. Spon, Ltd. Price 3s. each.

South African Conditions.—At Cape Town itself rath better business appears to have been done duri December than during the same month of the pr vious year, but in the rest of the Peninsula the bu is not quite so cheerful. There are so many big proje which will be proceeded with early this year that most of th trades are looking forward to seeing all their members fu employed. The electrification of the suburban lines is th largest undertaking, involving a sum of £2,000,000 spread ov two years, but there are building contracts about to start i volving large sums besides smaller ones representing at le half a million. The work on the extension of the Cape Tow docks will be speeded up during the year, which means em ployment for hundreds of men and the expenditure of lar sums, and the scheme of road construction and improvemen involves the spending of hundreds of thousands of pounds.— *Reuter's Trade Service* (Cape Town).

re.—The premises jointly occupied by the Defiance trical Co., Ltd., and the Peerless Light Co., Ltd., at ton Road, Wandsworth, S.W., were seriously damaged fire on January 27th.

anish Electrical Undertakings.—According to a return issued there was a decline last year in the amount of al invested in new electricity undertakings and the extension of old ones, in Spain, the amount of new capital being 47,069,000 pesetas, as contrasted with 161,025,000 pesetas 923, and 73,101,000 pesetas in 1922.

ew French Company.—La Société de l'Electricité is the e of a new company lately formed at Vigan (Gard) with a tal of 500,000 francs to establish a hydro-electric station lighting and power supply to the little towns of Vigan and e under a 40 years' concession.

ectrical Imports into Argentina.—The recently-issued ort of the British Chamber of Commerce in the Argentine ublic for 1923-24 states that the electrical imports have n small during the past year due to the excessive stocks orted in the preceding twelve months. Furthermore, competition is very severe, particularly on the part of representatives of German manufacturers.

rench Industrial Associations.—Among the new le associations lately formed in France, is one of ferro-concrete electric transmission mast producers. It is known as Syndicat des Constructeurs de Poteaux en Ciment Armé, its headquarters are at 29, Rue Lemercier, Paris. The ers of small fittings for electrical transmission lines have organised the Syndicat des Fabricants des Ferrures pour nes Electriques, with offices at 56, Rue de la Victoire, Paris.

Hackney Cross-Word Puzzle.—Although the cross-d puzzle vogue has penetrated almost every sphere we have ar been able to steer clear of any reference to it. We are compelled to abandon this unique position to refer to a s-word puzzle which the Hackney Electricity Department produced in conjunction with the E.D.A. The prizes for solution are attractive—a vacuum cleaner or a lighting installation, a fire or a fan, and eight other small electrical fances. The competition is for residents of the borough y.

Radio Apparatus Film.—MESSRS. L. MCMICHAEL, LTD., e arranged for the exhibition of a film advertising their io apparatus at a number of kinemas in London and the ne Counties.

ead.—Messrs. James Forster & Co. state in their letter January 31st:—"There is little change in the situation e our last report. Consumers have succeeded in holding the market, and prices, in consequence, fell away through t of their support. Demand for prompt lead has been rather modic, with the result that there is almost a glut of sup-s. How far the fall will go it is impossible to say, but erience teaches us that when once the ball starts rolling s very difficult to arrest its fall, particularly as it is known there are one or two large "Bull" accounts still to be idated. A return of confidence is the first thing necessary this will not come until prices show some signs of becon-stabilised."

ew Company.—CORRECTION.—In our last issue we recorded registration of Philips Lamps, Ltd. The names of the subscribers were not clear, but the company now informs that these were:—J. W. Beyen, Koekoelaan, Eindhoven, land, and D.C.F. van Eendenburg, Oosteinde, 235, Voor-g.

rade-mark Applications.—The following are among the nt applications for British trade marks. Objections against of the proposed marks may be entered within one month January 28th. In the case of foreign applications, the es and addresses of the British representatives are also n.

s Aerial (lettering and design). No. 450,838. Class 5.—Wire for s, telephonic and telegraphic aerials. E. & W. G. Makinson, Ltd., field Road, Preston.

e English Electric Co., Ltd. (lettering and semi-circular design). No. 8. All goods in Class 6. Also lettering and circular design. No. 9. All goods in Class 6.—The English Electric Co., Ltd., 28, Kingsway, don, W.C.2.

aphone. No. 452,482. Class 8.—Apparatus for use in wireless tele-y and telephony. H. Tyas, trading as Herbert Tyas & Co., The Arcade, ain Street, Mexborough, Yorks.

ervox. No. 454,031. Class 8.—Apparatus for use in wireless telegraphy telephony. The Edison-Swan Electric Co., Ltd., 123-125, Queen Victoria t, London, E.C.4.

(lettering and design). No. 453,181.—All goods in Class 8. Fritz Hof-n, trading as the Fritz Hofmann Elektrotechnische Fabrik, 39, Hofmann-se, Erlangen, Germany (Marks & Clerk, 57-58, Lincoln's Inn Fields, don, W.C.2).

ffin's Star Crystals (lettering and design). No. 453,848. Class 8.—Detec-crystals for use in wireless telephony and telegraphy. A. W. Griffin, trad-as A. W. Griffin & Co., 66, St. George's Road, Redditch, Worcestershire.

ntola. No. 454,006. Class 8.—Radio-receiving apparatus, telephone ers, loud-speaker telephones, radio frequency shielded flexibles for tele-e headsets, and electro-magnetic sound reproducers. Brandes, Ltd., 296, ent Street, London, W.1.

er-Ready. No. 447,067. Class 11.—Lamps (electrical), dry batteries and (electrical), accumulators (electrical), coils (electrical), all for medical ental purposes. The Ever-Ready Co. (Great Britain), Ltd., Holloway, don, N.7.

hler. No. 447,908. Class 18.—Installations for generating electric current. ler & Co., High Street, Kohler, Wis., U.S.A. (White, Langner, Stevens Parry, 88-90, Chancery Lane, London, W.C.2.)

N. Irvington Insulation (lettering and design). No. 445,842. Class 50.—trical insulating materials. Irvington Varnish & Insulator Co., Irving-N.J., U.S.A. (F. W. Golby, 3, John Street, Bedford Row, London, .1.)

n E.C.A. Scholarship Scheme.—The Council of the Elec-al Contractors' Association (Incorp.) has decided to institute or more scholarships of the total value of £75 per annum for three years for one or more indentured apprentices employed by members of the Association. Details will be announced later.

The Telephone Development Association.—We have received from this Association an attractive brochure, "The Case for More Telephones," in which the aims of the Association and a list of the members of the Council are set forth. The first part of the publication is devoted to an "odious comparison" of the telephone position in Great Britain and in other countries. It is disconcerting to find that Hawaii, which is not generally thought of as a hive of industry, is slightly ahead of this country so far as the telephone "density" is concerned—and so is Iceland. The Association does not enter into a discussion of the reasons, but sets out to improve matters. It is frankly acknowledged that the Association is not purely altruistic—more telephones mean increased business for its members. However, if we get the telephones we shall feel that the manufacturing members of the Association are entitled to their reward.

Local Exhibition.—GREENOCK.—During this week the Corporation Electricity Department has been holding a Home Electrical Exhibition to stimulate public interest in the many domestic applications of electricity. Shop-window lighting has also received attention, a lecture on the subject having been given for the benefit of shopkeepers.

Radio Valve Price Reductions.—Considerable reductions in the price of radio valves have been made by British manufacturers as from Monday last. They range from 1s. 6d. in the case of the lowest priced valves (making the price 11s.) to 5s. 6d. in the case of the 37s. 6d. valves, bringing the price to 32s. It is stated that the reason for the reduction is the rapid growth of the demand which has greatly lowered the cost of production. The policy of the manufacturers is to pass this benefit on to the users at once instead of waiting for the end of the season. The lower prices should act as a further stimulant to the demand, and many crystal users will no doubt take advantage of them.

Electrical Trade Competition: Support Required at Home.—"A Power Expert," writing on the "Growing Demand for Electrical Plant" in the *Manchester Guardian Commercial*, concludes his article as follows:—

"During 1924 the exports of electrical machinery constituted a record in the history of the industry, being over 20 per cent. above 1913 in weight, while a similar advance could be noted in electrical apparatus other than machinery. The world's market for electrical machinery and apparatus, if we limit attention to exports from the five main competing countries, Britain, the United States, Germany, France, and Switzerland, should be about 28 per cent. above the 1913 level, so that the British improvement of 20 per cent. scarcely corresponds to the general improvement. Other countries, the United States and Germany, are challenging Britain's position in many important markets, and Germany has now returned to the position she had before the war, when she supplied 50 per cent. of the world's requirements. The electrical industry will be faced with greater competition during 1925, largely through the operation of the Dawes Scheme and the stabilisation of currencies in Europe, than at any other time since 1914, and only unfailing support in the home market will allow it to retain its position intact in international trade."

The Uruguayan Electrical Market.—In a survey of conditions in Uruguay, *Commerce Reports* says that "slight improvement in the market for electrical goods is anticipated, with benefits tending to favour Germany."

The Electrical Trade of Paraguay.—According to *Commerce Reports*, the import returns of Paraguay for the first seven months of 1924, show a large increase in the amount of electrical goods supplied by the United States, while, at the same time, there has been a serious decline in the share of the United Kingdom in this trade. German imports also show a falling-off. During 1923 Paraguay imported electrical goods to the value of $49,841 (Argentine gold), 80 per cent. of which came from the United States and Argentina. It is estimated that the figures for the full twelve months of 1924 will show a 60 per cent. increase.

The trade in electrical goods is improving generally and there is a general opinion that it will continue to gain. In considering Paraguay as a market for electrical goods, it is of importance to note that only the larger cities are supplied with electricity.

The British Empire Exhibition, 1925.—The organisers of the 1925 British Empire Exhibition have sent us an advance folder outlining some of this year's arrangements. The catering question has apparently been settled by the allotment of the concession to a group of firms. The "Never-Stop" railway will be again in operation, and the admission charge will be the same as during last year, except upon Tuesdays, when it will be raised to 2s. 6d. The question of railway facilities is under consideration by the principal railway groups.

Electricity in Beet Sugar Production.—Following the order which it received a year ago for the electrical plant required by a sugar factory in Jamaica, the British Electric Plant Co., Ltd., Alloa, has now secured the order for the whole of the electrical machinery for the beet sugar factories that are being erected, one at Spalding and the other at Kidderminster. The total equipment comprises four 250-kW, three-phase alternators and 62 motors of sizes ranging up to 100 h.p.

A View of Japan.—Mr. Charles P. Martin, who has recently made a tour in the Far East, contributes some notes of his impressions to *The Ironmonger*. He says that his inquiries, pursued under some difficulties owing to his ignorance of Japanese, led him to conclude that the state of the hardware and steel trades in Japan, to say nothing of other trades, is very bad, and that the country is for the moment submerged beneath a wave of general business depression. Japan is suffering from the effects of the 1923 earthquake and the fires which resulted from it; the serious fall in the exchange in February last year; and the 100 per cent. Luxury Tax which hits resident foreigners severely as well as the Japanese themselves.

Power Station Cement.—The Birmingham Corporation has ordered from the Cement Marketing Co., Ltd., 400 tons of "ferrocrete," a new British rapid-hardening cement for use for the extension of its Nechells power station. The same kind of cement has also been specified for the Bedford Corporation electricity works extension.

Reval Fair.—An international Fair will be held at Reval from August 15th to 24th. The Fair will consist of 27 sections, covering commerce, industry and agriculture.—*Reuter's Trade Service* (Reval).

Australian "Dumping" Duties.—The imposition of "dumping" duties on certain articles, which were to have come into force on January 1st, has been postponed. Among the articles affected are electrical mining fuses, which will not be subject to the increased tariff until July 1st.

Unemployment.—There was a further decrease in the number of persons registered as wholly unemployed during the week ended January 19th, the total being 1,269,700 as compared with 1,279,854 a week earlier.

Lighting and Power Notes.

Aberdeen.—ELECTRICITY EXTENSIONS.—The Electricity Committee has approved a report recommending the extension of Ferryhill power station at a cost of £198,199. It was stated that the Electricity Commissioners had granted borrowing powers up to the amount mentioned.

Australia.—VICTORIA.—The Electric Supply Co. of Victoria, Ltd., has installed two turbo-generators, which will more than double the present capacity of its plant at Bendigo, and provide for a greater standard of efficiency in the working of the plant. The estimated cost of the installation is £50,000. The new plant consists of two 1,750-kVA, 6,600-V, three-phase, 50-cycle sets, which will enable the company to provide an ample and continuous supply to the town and the outlying districts. The turbo-generators, rotary converters, and transformers are all of English manufacture.

The Victorian Parliament has passed an Electricity Supply Bill authorising the application of £1,569,500 towards electricity schemes. Part of the money will be distributed as follows:—Power houses, transmission lines, terminal stations, and other works, £281,000; Morwell (brown coal) open cut workings, £112,000; Sugarloaf-Rubicon water-power scheme, £223,000.—*Reuter's Trade Service* (Melbourne).

Bradford.—NEW PLANT.—The 20,000-kW set to be erected at Valley Road station by the English Electric Co. has been running under steam at Rugby for tests, and is now to be taken down and re-erected at Bradford on a foundation which has just been completed. It will stand on the site of a former 1,000-kW set. It is expected that the work will be completed and the set ready for operation by Easter.

Brecon.—ELECTRICITY SCHEME.—The Town Council has decided to proceed with an electric lighting scheme for the borough.

Chesterfield.—ELECTRICITY SUPPLY.—Mr. Charles Markham, in offering the Corporation the gift of Tapton House and 200 acres of land, states that the Staveley Coal and Iron Co.'s cable passes through the estate, and he stipulates that the electricity consumed on the estate shall be taken in bulk from the company and distributed to the tenants at a price not exceeding that paid to the company, plus 100 per cent.

Continental.—FRANCE.—In order to study the questions appertaining to rural electrification, a new group, consisting of 200 deputies, has been formed in the French Chamber, under the leadership of MM. Le Trocquer and Victor Boret (honorary presidents) and M. Lesaché, acting president. The new group is drafting its programme, which includes the appointment of commissions to study questions calling for immediate settlement.

The Prefect of the Seine has handed to the Paris Municipal Council a memorandum proposing the outlay of 156,000,000 fr. for electricity extensions in the city and suburbs. The works will be undertaken by the municipal concern styled La Compagnie Parisienne de Distribution de l'Electricité. In February of last year the installation of additional plant at the Nord station of this company up to 330,000 kW was sanctioned.

Darley Dale.—OPPOSITION TO SCHEME.—As a result of the refusal of the North and South Darley Urban District Councils to permit the Derbyshire and Notts. Electric Power Co. to erect overhead cables from Matlock to Darley Dale, the company is appealing to the Ministry of Transport. Opp... tion is being organised, and a joint conference of the coun... and local property and land owners affected is to be held...

Dover.—LOAN SANCTIONED.—The Corporation has recei... sanction to a loan of £6,000 for mains and services.

SUPPLY TO GAS WORKS.—The Electricity Committee has c... sidered the report submitted by the borough electrical e... neer with regard to a d.c. supply to the Dover Gas W... works, and has recommended that the proposed cable be l... at an estimated cost of £1,000, provided the company e... into an agreement guaranteeing for ten years a minim... annual consumption of 20,000 kWh, with a maximum ... mand not exceeding 40 h.p.

Grimsby.—WORKS INSPECTION.—In connection with the ... cent installation of new plant, which we hope to describe in ... early issue, the Grimsby Corporation Electricity Works ... thrown open to the members of the Town Council and th... friends, and representatives of various other bodies on W... nesday evening, January 28th. A large number availed the... selves of the opportunity. It is twenty-five years since ... modest start was made and in the fourth year the undert... ing was brought on to a paying basis; the whole of the mo... contributed by the ratepayers has been repaid. The visit... were met on their arrival at the works by the chairman ... the Electricity Committee (Coun. W. H. Thickett, J.P.), ... after the electrical engineer and manager (Lt.-Col. W. ... Vignoles, D.S.O., M.I.E.E.), had by means of a sketch p... briefly described what they would see, the visitors w... escorted round by members of the staff who acted as guid...

Harwich.—ELECTRICITY SUPPLY.—The first of five sub-... tions to be installed at Harwich to complete a scheme ... electricity supply for the borough was put into commis... on January 21st, when the first electric lights of ... borough were switched on by the Mayor, Mrs. Robt. H... The supply for the town will be received in bulk from ... railway supply at Parkeston and distributed, after transfor... tion, throughout the borough. The sub-station which w... started up on January 21st is to supply the centre of ... town, and all five sub-stations are to be of a similar ty... Four will contain two 60-kVA transformers each and ... other will contain two 100-kVA transformers. The h... switchgear is all of the truck type, and the l.p. switchg... is of the open type on enamelled slate panels. The tra... formers are being supplied by the General Electric Co., L... the switchgear by the Metropolitan-Vickers Electrical Co., L... and the cables by Pirelli-General Co., Ltd. Over 100 c... sumers have already been connected to the mains.

India.—HYDRO-ELECTRIC DEVELOPMENT.—A number of e... trical schemes are contemplated or in progress. The Gove... ment of Madras has a scheme whereby it would secure ... artificial waterfall by converging to a head a few of ... more convenient waterways in the district of Malabar. T... work is estimated to cost Rs. 60 lacs, and the whole dist... would be supplied with electric power.

The Tata Power Co. will begin to supply electricity by ... monsoon of 1926. The four Tata hydro-electric conce... together will be able to supply 600 million kWh annually.—*Reuter's Trade Service* (Bombay).

Lancaster.—LOANS SANCTIONED.—The Town Council has ... ceived sanction to loans of £12,740 for mains and £20... switchgear.

London.—BATTERSEA.—We regret that in our last issue ... report of the past year's working of the Bermondsey und... taking was attributed to Battersea. We understand fr... Mr. Bond, the Battersea borough electrical engineer, that ... undertaking showed better financial results. We repeat ... week's note under its correct heading:—

BERMONDSEY.—The report on the working of the boro... electricity undertaking for the year ended March 31st ... shows that the gross profit for the year was £29,190. L... charges, interest, and contributions to superannuation f... amounted to £26,492, the remaining surplus being £2,... from which sum the cost of works of a capital nature ... the deficiency on the installation and sales account amount... to £1,524 have been met, the net surplus being £1,173. ... energy sold totalled 8,882,413 kWh, as compared with 8,683... kWh in the previous year, an increase of approximately 10 ... cent. The increase in the output since 1914 was 68 per c... 664 new services were laid during the year, as compared w... 243 in 1922-23.

Luton.—ELECTRICITY CHARGES.—The Corporation has ... cided that the charges for electricity in the following p... of the "added areas" be as follows:—(a) In the neighbo... hood immediately around Luton: The price charged wi... the borough, with an addition thereto of 10 per cent. ... Dunstable borough and its immediate neighbourhood: ... price charged in the borough, plus 25 per cent. (c) The w... districts of Leighton Buzzard and Linslade, and the im... diate neighbouhood: The price charged within the boro... plus 33⅓ per cent.

Middlesbrough.—CHANGE-OVER.—Sanction has been reco... to the borrowing of £9,946 in respect of the change of ... system of supply in the Southfield Road-Corporation R... area.

Mid-Lancashire Electricity Advisory Board.—The M... Lancashire Electricity Advisory Board has had under ... sideration the electrical development of the Fylde area, ... the subject was referred to the Engineering Advisory C...

mittee. This body has held a further conference at Blackpool to consider the matter.

Morecambe.—CHANGE-OVER.—The borough electrical engineer has submitted to the Electricity Committee a comparison between the estimated cost of change-over from d.c. to a.c., the expenditure incurred to date, and his estimate for completion, which showed the total amount required to be £48,000, as against the original estimate of £43,000, some of this amount being for extensions to mains and services and not actually due to the change-over. It was resolved to make application for sanction to the borrowing of a further £5,000.

Morocco.—CASABLANCA.—The 18,000-kW central station, designed primarily for the supply of electricity to the railways, will shortly be completed.

New Zealand.—WELLINGTON.—The report on the working of the Corporation electricity undertaking (engineer: Mr. M. Cable) for the year ended March 31st last shows a total revenue of £150,191, as compared with £133,884 in 1922-23. Working expenses amounted to £90,106, as against £89,050, leaving a gross profit of £60,085 (£44,834). After providing for interest, sinking fund, and other charges, there was a net profit of £12,868. The capital expenditure during the year amounted to £176,554. The sales of electrical energy increased from 7,685,318 to 8,231,812 kWh, and the average price obtained rose from 4.18d. to 4.23d. per kWh.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

LONDON.—*The County of London Electric Supply Co., Ltd.*—Lighting: 5½d. per kWh, plus 30 per cent. Power: 2½d. per kWh, plus 40 per cent. Heating: 1½d. per kWh, plus 40 per cent.

LEICESTER.—Lighting: 5d. per kWh for the first 1,200 kWh per quarter; all energy in excess of this amount, 4½d. per kWh. Late-hour shop-window lighting: A special rate of 3d. per kWh has been introduced.

BURNLEY.—Heating and domestic appliances: First 150 kWh, 1½d. per kWh; additional energy, 1d. per kWh. Outside the borough: First 150 kWh, 1¾d. per kWh; all energy in excess, 1¼d. per kWh.

DARWEN.—Lighting: from 6d. to 5½d. per kWh. Power, heating, &c.: Varying from 2½d. per kWh for the first 100 kWh consumed per quarter to 1d. per kWh over 4,000 kWh. Domestic power and cooking: First 30 kWh, from 3d. to 2½d. per kWh; next 300 kWh, from 1½d. to 1¼d.

Plymouth.—LOAN SANCTIONED.—It was reported at a recent meeting of the Electricity Committee that sanction had been received to a loan of £28,500 for the provision of new boilers at the Prince Rock generating station.

Rochdale.—SPECIAL ORDER.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation a Special Order made by them authorising the Corporation to supply electricity in the urban districts of Norden and Wardle.

Shipley.—ELECTRICITY SUPPLY.—At a recent meeting of the Electricity Committee a report was submitted upon an interview with representatives of the Bradford Corporation with regard to additional supplies of electricity, and also supplies to property in course of erection near the city boundary. The Committee considered it desirable that the supply to houses in course of erection at Gaisby and proposed at Leeds Road, Thackley, should be given from the Corporation mains. The clerk was instructed to inform the Corporation that no objection to an Order authorising such a supply would be raised, providing that provision is made to enable the Council to take over the supply upon reasonable terms when the mains have been extended so as to enable this to be done. The Yorkshire Electric Power Co. is to be invited to submit terms for a bulk supply of electricity to supplement the supply from the Council's works.

Southam.—SPECIAL ORDER.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation a Special Order made by them to be granted to the Midland Electric Light & Power Co., Ltd., for the supply of electricity by the Leicestershire and Warwickshire Electric Power Co. to certain parishes in the rural districts of Southam and Warwick.

Southampton.—SPECIAL ORDER.—The Corporation is applying for a Special Order for the supply of electricity to certain parishes in the rural district of South Stoneham.

Spalding.—SPECIAL ORDER.—The Urban District Council is applying for a Special Order authorising it to supply electricity in the urban and rural districts.

United States. — HYDRO-ELECTRIC DEVELOPMENT. — The Federal Power Commission has issued a licence authorising the Susquehanna Power Co. to utilise the Susquehanna River for generating electricity. According to *Power*, a dam is to be constructed at Darlington, near the head of Chesapeake Bay, and the initial installation will include six generators with a total capacity of 280,000 h.p. Four additional sets will be installed later, which will raise the capacity of the plant to nearly 500,000 h.p. Two 220,000-V transmission lines are to be erected at first, and the right-of-way is being provided for a third, to be erected later. The energy will be sold to the Philadelphia Electric Co. The estimated cost of the scheme is $32,000,000.

Winchester. — CORRECTION. — The electricity extensions which, through the error of a correspondent, were attributed to Winchester in our last issue should have been credited to Basingstoke. Mr. R. Ayton, in drawing our attention to the error, considers that the information is liable to be misleading to manufacturers in connection with certain work which his Department has under consideration; and we trust that this correction will make matters clear.

Wrexham.—EXTENSION OF SUPPLY.—The Town Council is applying for an Order to extend its area of electricity supply so as to include the rural district or parts thereof. The Corporation proposes to fix the same maximum price as that in force in the borough, namely 8d. per kWh.

York.—NEW PLANT.—The Electricity Committee has received a report from the city electrical engineer on a proposal to install additional plant at the Foss Islands power station. He states that the maximum load during the past 12 months has increased from 5,891 to 6,627 kW, and that it will be increased by further loads which will be taken up during this year in connection with the supply to the London and North-Eastern Railway Co., of 1,500 kW, and to Messrs. J. Terry & Sons, Ltd., of 300 kW, in addition to the estimated increase of 500 kW in the load for small consumers. He therefore recommends the following extensions:—Foss Islands power station: One 6,000-kW turbo-alternator, condenser, and switchgear (£24,000); new suction and discharge pipes to River Foss (£2,000); two 25,000-lb. boilers, &c. (£20,000); steel chimney (£600); one 1,500-kW motor generator, switchgear, &c. (£5,500); necessary alterations to buildings (£4,000). At Lendal Bridge sub-station: One 1,000-kW motor generator, switchgear, and cables (£4,000). Feeder cables, to be laid during the summer (£15,147). The Committee has submitted the report to the Council for approval, and recommends that application be made for sanction to the scheme and to a loan to carry out the work.

Tramway and Railway Notes.

Belgian Congo.—RAILWAY ELECTRIFICATION.—The Commission appointed some time ago to inquire into and report on the practicability of electrifying the railway between Matadi and Leopoldville in the Belgian Congo has now presented its report, which is in favour of the project. It is recommended, however, that a commencement should be made with the section between Matadi and Sognololo, a distance of about 60 miles, which has the most severe gradients on the system.

Chile.—RAILWAY ELECTRIFICATION.—Work is now in hand in connection with the electrification of the Trans-Andine line as far as the Argentine frontier.

Continental.—AUSTRIA.—According to the *Montag Journal*, the president of the Austrian State Railways, Herr George Guenther, is to visit London to confer with a financial group concerning a £5,000,000 credit for the purpose of electrifying the State Railways.

Littleborough.—TRAMWAY AGREEMENT.—Representatives of the Urban District Council are to meet a sub-committee of the Rochdale Tramways Committee in connection with the question of the extension of the existing tramway agreement.

New Zealand.—WELLINGTON.—The accounts of the Corporation tramway undertaking (engineer: Mr. M. Cable) for the year ended March 31st last record a total revenue of £393,565, as compared with £389,931 in the preceding year. Working expenses totalled £305,152, as against £297,496, leaving a gross surplus of £88,413 (£92,435). After deducting capital charges, there was a net surplus of £9,070, as compared with £19,044 in 1922-23. The number of passengers carried increased from 37,499,813 to 38,732,030, and the car-miles run from 3,265,417 to 3,354,202. The electricity for the tramways is supplied from a separate power station to that operated by the lighting department, and the surplus power not required by the tramways was sold to 513 consumers. The revenue from this source during the year was £43,718, and, after meeting all charges, there was a net profit of £8,824.

Preston.—TRAMWAY ROUTE FLOODED.—Tram traffic was suspended, on January 28th, on the Penwortham section of the Corporation tramways, due to the River Ribble overflowing its banks.

Sunderland.—FARES.—A return to pre-war fares has been decided upon by the Tramways Committee. Ordinary fares which are now 1½d. will be reduced to 1d., and ½d. will be taken off all the higher fares. It is estimated that the reduction will represent a loss in revenue of between £20,000 and £25,000 annually.

NEW ROUTES.—The Minister of Transport has given his decision with regard to the application of the Corporation for powers to extend its tramway system along Durham Road and to construct a loop line from Holmeside *via* Derwent Street and Back Mary Street. The Minister is prepared to authorise the Durham Road extension subject to certain conditions. The Derwent Street loop will be authorised on the understanding that it is used for unidirectional traffic only. The Tramways Committee has decided to accept the conditions laid down, and to ask the Minister to issue the necessary Order.

Torquay.—OMNIBUSES.—It is announced by Mr. W. B. Cownie, managing director of the Devon General Omnibus Co., and Torquay Tramways Co., that following the Torquay Corporation's decision that motor buses shall be allowed to compete with the Tramways Co., on the Torquay to Paignton route that the company has decided to order 12 motor-buses to ply for hire between Torquay and Paignton.

Tramway Fares.—The Minister of Transport has extended the period for increased charges by various tramway undertakings, under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, and the Tramway (Temporary Increase of Charges) Act, 1920, until December 31st, 1925, including the following undertakings—Camborne and Redruth tramways of the Urban Electric Supply Co., Ltd.; Bath Electric Tramways, Ltd.; Brighton Corporation; Bristol Tramways & Carriage Co., Ltd.; Kidderminster and Stourport Electric Tramways Co.; Maidstone Corporation; Middlesbrough Corporation; Swindon Corporation; Rawtenstall Corporation; Rochdale Corporation; Yorkshire (West Riding) Electric Tramways Co., Ltd.; Yorkshire (Woollen District Electric Tramways, Ltd.; Scarborough Tramways Co.; Aberdare Urban District Council; Burnley Corporation; Hastings Tramways; and Ipswich Corporation.

United States.—RAILWAY ELECTRIFICATION.—*Power* reports that the Pennsylvania Railroad is to electrify its lines between New York and Washington (Pa.) in the near future. This involves a four-track system about 220 miles in length, and an expenditure of about $50,000,000. It is stated that all electrical energy will be purchased from utilities situated along the lines.

Walsall.—RAILLESS CARS.—The Town Council has decided to promote a Bill empowering the Corporation, amongst other things, to provide and run railless cars on further routes.

York.—RAILLESS CARS.—The Tramways Committee has recommended to the City Council that powers be obtained to extend the railless-car system from the present terminus at Heworth, *via* the Tang Hall municipal housing estate to Hull Road.

Telegraph and Telephone Notes.

Australia.—"BEAM" RADIO STATIONS.—A contract involving £120,000 has been entered into between Amalgamated Wireless (Australasia), Ltd., and the Marconi Company, Ltd., for the erection of two beam radio telegraph stations in Australia for communication with England and Canada. Certain minor clauses have yet to be completed before the agreement is signed. Senator J. D. Millen, the Federal Government's representative on the board—the Commonwealth holds £501,000 of the company's paid-up capital of £1,000,000—informed the Sydney *Daily Telegraph* that arrangements would be made shortly for the erection of another station to serve traffic to and from the East. The station for English traffic would be set up first, but the site—as in the case of the Canadian traffic station—had not yet been selected. The Amalgamated Co. would provide the sites, and also arrange for the provision of the power to be used by the stations.

The contract provided, he said, for the operation of the first station within 12 months of the date of its signing. A guarantee was being given by the Marconi Co. that the station would be capable of handling 43,000 words duplex daily, which was double the total that had been provided for in the earlier proposal, and penalties for failure to complete the undertakings given by the Marconi Co. were contained in the agreement, which differed materially from that entered into with the same company by the British Government. No royalty for the use of patents would be paid, whereas the British Government would have to pay 6½ per cent. royalty. The contract would have to be sent abroad for signing, but that would not delay the preliminary work. Of the £120,000 to be paid for the two stations, £75,000 would go to the first to be erected for traffic with Britain.

Eastern Cable Companies.—INVENTIONS COMMITTEE.—The Eastern Associated Group of Cable Companies has appointed a Suggestions and Inventions Committee to examine proposals, suggestions, or inventions submitted by employés. To encourage the submission of ideas, the companies are awarding three £25 prizes in the first 12 months, which will be paid whether ideas are adopted or not, says the *Morning Post*, a payment in addition to anything which may be made for an adopted proposal.

Hull.—YEAR'S WORKING.—The profits of the Hull Corporation telephone undertaking for the past financial year have amounted to over £10,000, says *The Times*. It is also reported that the Telephone Committee has accepted a British tender for cable rather than a cheaper German tender.

Italy.—TELEPHONE TRANSFER.—The Italian Government, which is handing over the administration of nearly the whole telephone system of the country to private enterprise, has awarded the concession for one of the five zones to a combine of the L.M. Ericsson Company, Stockholms Enskilda Bank, Hambro's Bank, and the Fatme telephone works at Rome. The holders of the concession will modernise and develop the telephone service of the zone, which comprises Southern Italy and Sicily, with 22,000 subscribers. The concessions for the other four zones have been awarded to Italian firms, some of which have concluded agreements with the Ericsson concern for technical assistance.—*Reuter's Trade Service* (Stockholm).

Norway.—BUDGET REDUCTION.—The Government has reduced to almost one-quarter the budget estimates of the telegraph administration's proposed expenditure in the ensuing financial year, so that the total outlay will be only 6,556,000 kr., as compared with nearly 25,000,000 kr. which had been asked for. The former figure includes 2,000,000 kr. for the continuation of the work of reconstructing the telephone system in Oslo, 1,300,000 kr. for the completion of the Stavanger radio station, and 40,000 kr. for that of the Spitsbergen radio station. The Stavanger station is expected to be ready this year.

Philippines.—NEW RADIO STATION.—Representatives of the Radio Corporation of America announce that plans have virtually been completed for the erection of a large radio station at Manila. The transmitter, with eight steel towers, will be located on Mariveles Peninsula, near the entrance to Manila Bay, within the United States Navy Reserve. The receiver will be about three miles from Manila. A submarine cable will connect the two, and both will be remote controlled from a building in the business centre of Manila. Testing has been carried out in the last few weeks under the direction of Admiral Bullard. It is said the project will involve an outlay of $4,000,000.—*Reuter* (Manila).

Spain.—TELEPHONE FRAUDS.—Investigations show that defalcations in the Spanish National Telephone Co. reach several millions of pesetas (a peseta is nominally worth 9½d.). The cashier, Gomila, and the inspector, Escribano, have been committed to prison and bail has been refused. The arrest of other high officials of the company is expected. The frauds extend over a long period previous to the formation of the present company, so that American and British interests in the new concern are not affected.—*Daily Mail.*

Radio Notes.

Radio Conference.—AMATEURS' MEETING.—Amateurs will hold their first international conference at Easter, when delegates from Canada, North and South America, and most European countries will meet in Paris, says the *Daily Mail*. It is intended to form the International Amateur Radio Union, the object of which will be to get uniformity of treatment for amateurs of the different countries in certain ways. Among the subjects to be considered are international communication between amateurs—it is sought to make as easy as possible two-way communication between any two countries—and the question of an international radio language.

City Council Proceedings.—NOTTINGHAM.—Important debates at the City Council meetings are to be broadcast from the local B.B.C. station.

BIRMINGHAM.—The British Broadcasting Co. has requested the City Council to permit its proceedings to be broadcast on special occasions.

London Station.—REMOVAL.—It is understood that the aerial and transmitting plant of the British Broadcasting Co.'s London station (2LO) are to be moved from Marconi House in the Strand to premises further west. It is hoped to complete the arrangements about the middle of this month, when the station's power will be increased from 1½ to 3 kW. The new plant will be connected with the Savoy Hill studios by a 1½-mile cable, and two new studios are nearing completion, making a total of four. Two steel lattice towers, each 125 ft. high, have been erected; their tops are about 225 ft. above the roadway level, and the distance between them is 25 ft. The inverted "L" aerial will consist of two "sausages," each having five wires. The transmitters and other plant is housed in two huts on the roof of the building.

Request for Another Relay Station.—SOUTH-EAST KENT.—Fearing that the new high-power station which is being established at Daventry to replace the one at Chelmsford will not be able to serve the many crystal and small sets which have come into use in South-Eastern Kent, listeners in that district are, we hear, drawing up a petition to the B.B.C. asking that a relay station be established at Ashford, or Canterbury, to serve that part of the country.

Sweden.—NEW STATIONS.—The Swedish Radio Service Co. has started operations, and three or four stations have been heard testing. According to the *Daily Mail* the new Gothenburg station (SASB) is to give regular concerts about 8 p.m. on 290 metres, and the long-wave station at Boden (2,500 metres) will probably be transmitting regular programmes next month.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names of makers or suppliers of:—

A two-way ceiling switch patented by G. MATT, and marked with G in a circle.

An electric sealing wax heater marked I V.

P.B. SIMPLEX vacuum cleaners.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Ashford (Kent).—February 23rd. Electricity Department. Three 400-kW, 3-phase alternators, 15 e.h.p., 6,600-V switchgear cubicles. (See this issue.)

Australia.—SYDNEY.—March 30th. Municipal Council. Maximum demand indicators.*

MELBOURNE.—March 4th. Victorian Government Railways. Telephone equipment.*

April 1st. Electrical equipment for motor coaches and trailers.*

Postmaster-General's Department. March 10th. Primary battery parts.*

Ayr.—Town Council. Electrical work at 102 houses. Schedules from Town Clerk.

Bargoed (Glam.).—February 16th. Gellygaer Urban District Council Electricity Department. Six months' supply of cable, house service prepayment meters, cut-outs, overhead line material, poles, &c. (See this issue.)

Belfast.—February 9th. L.M. & S. Rly. Northern Counties Committee (Ireland). Twelve months' supply of stores, including telegraph ironwork, wire, electric lamps, porous pots, &c. Forms (6d.) from Mr. P. J. Martin, stores superintendent, York Road Station, Belfast.

February 26th. Electricity Committee. Stores for 12 months, including electrical accessories, lamps, carbon brushes, meters, cables, &c., &c. (See this issue.)

Belgium.—February 13th. Municipal authorities of Petit Spauwen (Limbourg province). Establishment of a l.p. electricity supply distribution system in the town.

Brandon and Byshottles.—February 14th. Urban District Council. Poles, &c., for street lighting and overhead mains on Meadowfield housing site. Plans, &c., from Mr. J. Plummer, Engineer's Offices, Brancepeth Colliery, Willington, Co. Durham.

Bridlington.—February 16th. Electricity Works. One 400-kW steam turbine, reduction gear, and d.c. generator. (January 30th.)

Cardiff.—February 20th. Electricity Department. 12 months' supply of paper-insulated cables. (See this issue.)

Chile.—SANTIAGO.—March 2nd. State Posts, Telegraphs and Telephones Department. Telegraph material, including copper wire, insulators, &c.*

February 27th. Arica-La Paz Railway. Miscellaneous materials, including copper, steel, and g.i. wire, electric wire for electric welding, &c.*

Croydon.—March 2nd. Electricity Department. 60,000-lb. water-tube boiler equipment. (January 23rd.)

Darlington.—February 25th. Electricity Works. Trolley omnibuses and reconstruction of overhead equipment. (See this issue.)

Denmark.—COPENHAGEN.—February 17th. Two electrically-driven gas pumps, with transmission, motors, &c.*

Egypt.—CAIRO.—February 14th. Egyptian State Railways. 10,000 metres submarine cable, and telephone materials. Tenders to Inspecting Engineer, Queen Anne's Chambers, Broadway, Westminster.—*Reuter's Trade Service* (Cairo).

Finland.—HELSINGFORS.—April 1st. Government Water Power Department. Materials for the sector sluice and turbine chambers for the equipment of the hydro-electric plant at Imatra.*

Heywood.—February 11th. Electric lighting installation at East Ward Working Men's Club premises, Olive Street. Particulars from Mr. F. Mayall, secretary.

India.—March 9th. Bombay, Baroda, and Central India Railway Co. Electrification of Bombay suburban lines:—Overhead equipment of permanent way and overhead transmission and distribution lines. (January 23rd.)

Kilmarnock.—Town Council. Electric lighting installation for the New Mill Road housing scheme.

Latvia.—RIGA.—February 23rd. Marine Department. Two/four electrically-driven cranes.*

London.—METROPOLITAN WATER BOARD.—February 11th. Twelve months' supply of stores, including electric lamps. Chief Engineer, Metropolitan Water Board, 173, Rosebery Avenue, E.C.

H.M. OFFICE OF WORKS.—February 12th. C.i. switches and fuseboards. (January 30th.)

February 18th. Steel conduits and fittings for electric wiring. (See this issue.)

HAMMERSMITH.—February 18th. Electricity Department. Twelve months' supply of stores, including electrical goods, insulated wires, meters, l.p. cable, &c. (January 30th.)

Manchester.—February 10th. Tramways Committee. Permanent-way special track work. Mr. H. Mattinson, general manager and chief engineer, Corporation Tramways, 55, Piccadilly, Manchester.

February 18th. Electricity Committee. Mercury-arc rectifying equipment (Spec. No. 90). Specification from Mr. S. L. Pearce, manager, Electricity Department, Town Hall.

February 13th. Electricity Department. 350 weldless steel lamp columns and c.i. and malleable iron accessories for street lighting. (See this issue.)

Merthyr Tydvil.—The Corporation Housing Committee will shortly invite tenders for electric lighting installation at 126 houses.

New Zealand.—WELLINGTON.—April 14th. Public Works Tender Board. Sub-station switchgear extensions for the Lake Coleridge power scheme.*

Post and Telegraph Department. March 15th. Switches and diaphragms.*

Portsmouth.—Electricity Department. One 6,000-kW turbo-alternator, with condensing plant, two 30,000-lb. per hour capacity water-tube boilers, with steel bunkers and economisers. (See this issue.)

Rochdale.—February 18th. Gas and Electricity Committee. Electricity sub-station, Silk Street, Sudden. Mr. F. H. Rudd, engineer and manager, Electricity Works, Dane Street.

Salford.—February 23rd. Electricity Department. One 1,500-kW rotary converter, with transformer and starting gear complete. (See this issue.)

South Africa.—JOHANNESBURG.—April 6th. South African Railways and Harbours. One 5-ton and three 4-ton electrically-operated portal cranes.*

Southport. — February 9th. Electricity Department. 10,000 yd. l.p. paper-insulated cables (various sizes). (January 23rd.)

South Shields.—February 16th. Electricity Supply Department. One 30-ton overhead electric travelling crane.

February 25th. One 1,000-kW rotary converter, with transformer, &c. (See this issue.)

Tanfield (Co. Durham).—February 19th. Urban District Council. Overhead line, underground h.p. cable, and sub-station equipment. (January 23rd.)

Transylvania.—TIMISOARA.—March 26th. Municipal Electricity Works. Turbo-generator, Scott transformers, h.p. feeder and accessories.*

Tynemouth.—February 10th. Electricity Department. One 250-kVA and one 400-kVA transformers. (January 23rd.)

Uruguay.—MONTEVIDEO.—March 5th. State Electricity Works. Steel and phosphor bronze wire, steel and copper bars and sheets.*

March 9th. 4,500 metres g.i. water tubes and 47,115 fittings for same.*

March 10th. Miscellaneous goods (including flexible steel cable, &c.).*

March 16th. Porcelain insulators and brackets.*

Warrington.—February 16th. Electricity Department. Motors and transformer. (January 30th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Australia.—MELBOURNE.—The Tramways Board has accepted the tender of the Foundation Co. of England and America of £56,247 for the construction of a tramway from Melbourne to South Melbourne.—*Reuter's Trade Service* (Melbourne).

Birmingham.—
Electrical installation at the Upper Thomas School, Birmingham (£486).—Ellis & Ward, Ltd.

Falkirk.—Electricity Department. Accepted:—
One patent straight tube, vertical type, water-tube boiler, 5,000 ft. heating surface, 200 lb. working pressure.—John Thompson Water Tube Boilers, Ltd.

Guildford.—Board of Guardians. Accepted:—
Installing electric light at the Institution (£1,086).—James Harris. There were 20 tenders, the highest being £2,881.

Halifax.—Tramways and Electricity Committee. Accepted:—
One 300-ampere-hour storage battery (£611).—Fuller's United Electric Works, Ltd.

Hull.—The Corporation Telephones Committee last week accepted a tender for cable from Messrs. W. T. Henley's Telegraph Works Co., Ltd., in accordance with the instructions of the City Council, who refused to accept a lower tender for German-made cable. The English tender of £981 was £180 more than the German offer.

London.—INDUSTRIAL AND MINING SUPPLIES CO., LTD. Accepted:—

Six months' supply of gasfilled electric lamps to the Bedwas Navigation Colliery and the Hoyland Silkstone Coal & Coke Co.—Siemens and English Electric Lamp Co., Ltd.

LONDON, MIDLAND & SCOTTISH RAILWAY.

Metal-filament train-lighting lamps.—Edison Swan Electric Co., Ltd.

LONDON COUNTY COUNCIL.—Mental Hospitals Committee.

Two electric motors for Cane Hill Hospital (£553).—English Electric Co., Ltd. (Accepted.)

Underground electric cable from the Brighton Road to the boiler house (£545).—County of London Electric Supply Co., Ltd. (Accepted.)

Highways Committee. 4,500 tons (approx.) of track rails during the year 1925-26, and alternatively 3,500 tons during the first six months, with the required quantity of lipless track rails (200 tons) and fastenings:—

	For about 3,700 tons during six months.	For about 4,700 tons during twelve months.
F. Mott & Co., Ltd., London, E.C., agents for Otto Wolff & Co., Duisburg, Germany (incomplete tender, the fishbolts being omitted)	£34,675	£44,000
Bolckow, Vaughan & Co., Ltd. (Accepted.)	34,798	**44,280**
Cargo Fleet Iron Co., Ltd.	37,071	47,146
Dorman, Long & Co., Ltd.	37,336	47,483

Supply of about 700 tons of conductor rails (12 months):—

Dorman, Long & Co., Ltd. (not to specification)	£8,787
Frodingham Iron and Steel Co., Ltd. (Accepted.) ...	**9,697**
Bolckow, Vaughan & Co., Ltd.	12,655

Manchester.—Electricity Committee. Accepted:—

Cable.—Western Electric Co., Ltd.

Steel flues for air heater.—Matthews & Yates, Ltd.

6,600-V sub-station switchgear.—General Electric Co., Ltd.; Park Royal Engineering Co., Ltd.; Ferguson, Pailin, Ltd.

Electric street lanterns.—General Electric Co., Ltd.; Cable Accessories Co., Ltd.; W. E. Beardsall & Co., Ltd.

Electric wash boilers.—Geo. Nobbs, Ltd.; Carron Company; Jackson Electric Stove Co., Ltd.

Tramways Committee. Accepted:—

Tramway rail bonds.—T. Bolton & Sons, Ltd.; Forest City Electric Services Supply Co.

Tramcar bodies.—English Electric Co., Ltd.

Tramcar trucks.—Electro-Mechanical Brake Co., Ltd.

Tramcar motors and controllers.—British Thomson-Houston Co., Ltd.

Salford.—Electricity Committee. Accepted:—

12,250 yd. l.p. cable (£4,482).—W. T. Glover & Co., Ltd.

Installation of electrically-operated clocks and motor siren at the Agecroft power station (£148).—Gent & Co., Ltd.

South Africa. — BLOEMFONTEIN. — The Vickers-Spearing Boiler Co., Ltd., London, have recently secured in the face of keen competition an important contract from the Bloemfontein Municipal Electric Supply Department, South Africa, for the complete boiler-house equipment of its new generating station. This comprises four Vickers-Spearing water-tube boilers, each capable of a maximum evaporation of 37,000 lb. per hour at 265 lb. per sq. inch, with superheaters to give a final steam temperature of 600 deg. F. One horizontal-tube economiser is superimposed on each boiler. The stokers are of the forced-draught, "Illinois" chain-grate type. The boilers are to be run under balanced draught conditions, and induced-draught fans are included, as well as two steel chimneys, the whole of the steam, water and air piping, feed and service pumps, deaërators, evaporators, tanks, and water-softening plant. Messrs. G. M. Clarke & Partner are the consulting engineers for this scheme.

Forthcoming Events.

Northampton Engineering College, Engineering Society.—Monday, February 9th. At the Institute, St. John Street, E.C. At 5.30 p.m. Paper on "Ball Bearings," by Mr. F. O. Moysey.

Association of Mining Electrical Engineers (London Branch).—Tuesday, February 10th. At the Engineers' Club, W. At 6.30 p.m. Paper on "Switchgear for Mines," by Mr. H. W. Clothier.

Institute of Marine Engineers.—Tuesday, February 10th. At the Institute, The Minories, E. At 6.30 p.m. Presidential address.

National Association of Supervising Electricians.—Tuesday, February 10th. At St. Bride's Institute, E.C. At 7.15 p.m. Annual general meeting.

Saturday, February 14th. At the Holborn Restaurant. Annual dinner.

Manchester Association of Engineers.—Tuesday, February 10th. At the Midland Hotel, Manchester. Annual dinner.

Institution of Heating and Ventilating Engineers.—Wednesday, February 11th. At The Old Colony Club, Aldwych, W.C. At 2.30 p.m. **Annual** general meeting. Presidential address by Mr. A. A. Jones. Paper on "Unsettled Questions in Heating and Ventilation," by Mr. A. H. Barker.

Institution of Electrical Engineers.—Thursday, February 12th. At the Hotel Cecil, Strand, W.C.2. At 7 for 7.30 p.m. Annual dinner.

(INFORMAL MEETING).—Monday, February 9th. At the Institution, Victoria Embankment, W.C. At 7 p.m. Discussion on "Broadcasting," to be opened by Capt. P. P. Eckersley.

(Irish Centre, Dublin).—Thursday, February 12th. At Trinity College, Dublin. At 7.45 p.m. Paper on "The Services of the Electrical Engineer in the Post Office," by Mr. J. H. Shaw.

(North-Eastern Centre).—Monday, February 9th. Annual dinner.

(North-Midland Centre).—Tuesday, February 10th. At the Hotel Metropole, Leeds. At 7 p.m. Informal discussion on "Domestic Electrical Apparatus."

(Scottish Centre).—Tuesday, February 10th. At 207, Bath Street, Glasgow. At 7.30 p.m. Paper on "Three-Wire Direct-Current Distribution Networks: Some Comparisons in Cost and Operation," by Mr. H. W. Taylor.

(Scottish Students' Section).—Friday, February 13th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Some Electrical and Physical Problems Affecting Long Range Radio Communication," by Mr. G. C. Colmar.

(Dundee Sub-Centre).—Thursday, February 12th. At the University College, Dundee. At 7.30 p.m. Paper on "The Utilisation of Tides for the Production of Power," by Prof. A. R. Fulton.

(East-Midland Sub-Centre).—Tuesday, February 10th. At the College, Loughborough. At 6.45 p.m. Paper on "A General Survey of the High-Pressure Switchgear Field," by Mr. S. Ferguson.

(North-Western Centre—Students' Section).—Tuesday, February 10th. At Milton Hall, Deansgate, Manchester. At 7.30 p.m. Paper on "Testing Insulating Materials," by Mr. F. S. Edwards.

(Sheffield Students' Section).—Wednesday, February 11th. At the University, Sheffield. Paper on "Magnets," by Mr. C. Harrison.

Royal Institution of Great Britain.—Thursday, February 12th. At 21, Albemarle Street, W. At 5.15 p.m. Lecture on "The Properties and Structure of Quartz," by Sir William Bragg, F.R.S.

Association of Engineering and Shipbuilding Draughtsmen (Birmingham Area).—Thursday, February 12th. At the Chamber of Commerce, Birmingham. At 7.30 p.m. Lecture on "Boiler-house Lay-out and Management," by Mr. P. S. Woolley.

Physical Society of London.—Friday, February 13th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Annual general meeting. Presidential address by Mr. F. E. Smith, F.R.S., on "A System of Electrical Measurements."

London Electrical Engineers Old Comrades' Association.—Friday, February 13th. At the Bridge House Hotel, London Bridge, S.E. At 8 p.m. Annual smoking concert.

Junior Institution of Engineers.—Friday, February 13th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecture on "Milestones in the Development of the Prime-mover Locomotive," by Mr. L. Pendred.

Edinburgh Electrical Society.—Friday, February 13th. At the Philosophical Institute, 4, Queen Street. At 8 p.m. Paper on "Radio Transmission," by Mr. W. Winkler.

British Electrical and Allied Industries Research Association.—Friday, February 13th. At the Savoy Hotel. Annual general meeting. Luncheon 1 p.m.

Notes.

St. Paul's Cathedral Appeal.—The following items have appeared in the list of contributions received by *The Times* since our last issue went to press:—

J. Stone & Co., Ltd.	£105 0 0
Babcock & Wilcox, Ltd.	105 0 0
Sloan Electrical Co., Ltd.	25 0 0

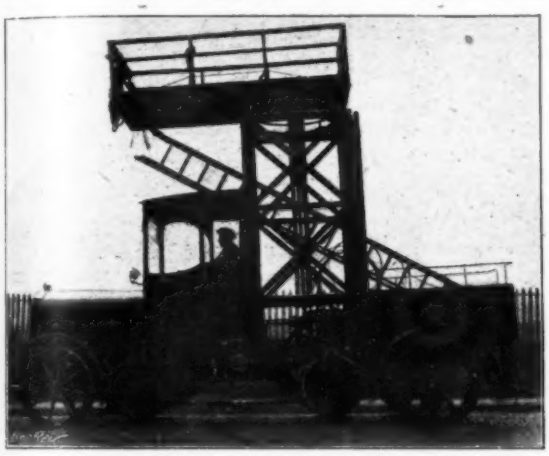
The Mersey Tunnel.—As a result of representations made by Sir Archibald Salvidge, the Chairman of the Merseyside Co-ordination Committee, the Government has made an offer of an additional grant of £1,000,000 to the grant of £2,375,000 promised by the late Government, towards the cost of a new tunnel under the Mersey between Liverpool and the Cheshire bank. The cost is estimated at about £6,000,000, and it is considered that the Government's offer will enable the undertaking to be carried out. At a meeting held last week Sir Archibald Salvidge said that efforts should be made to promote a Bill authorising the construction of the tunnel in the forthcoming session of Parliament, so that work could commence early next winter.

The Sullivan Marine Galvanometer.—From one of the first cable electricians to test the late Mr. Sullivan's marine galvanometer at sea during a cable repairing expedition—Mr. J. Rymer-Jones—we have received the following note:—In 1895 submarine-cable electricians were much relieved and not a little surprised to learn that Mr. H. W. Sullivan had succeeded in suspending the coil of a d'Arsonval galvanometer (designed by d'Arsonval for use on shore) so tightly by means of a phosphor-bronze wire of great tensile strength as to practically get rid of any important amount of sag when the ship was disturbed by a rolling or pitching movement; by means of a flexible lead wire attached to the front and another to the back of the aluminium former on which the coil was wound, which could be bent so as to balance—more or less successfully—both the two sides and also the back and front of the suspended coil, it was thereby rendered capable of being used as a marine galvanometer and thus secured the advantages of the d'Arsonval principle, *viz.*, great sensitiveness as compared with Sir William Thomson's (Lord Kelvin's) so-called "iron-clad" galvanometer—until then universally employed on board ship—and even the more important advantage that the ship could now be made to box the compass without the spot of light shifting its position on the scale. This last mentioned difficulty had been a constant cause of worry to cable electricians because the Thomson galvanometer—consisting as it did of a mirror with a very small magnetic needle of only a few grains weight attached to its back and the whole suspended within the galvanometer coil by means of a silk fibre—required that its true zero position on the scale should be checked after, and even during each insulation test in case the ship's direction had been even slightly altered and the instrument's zero changed in consequence. It will therefore be easily realised that the substitution of the Sullivan marine form of galvanometer for the old ironclad was hailed with enthusiasm by cable-ship electricians, who owe to Mr. Sullivan's successful pioneer efforts a debt which cannot well be over-estimated. Very great, however, as are the advantages of the Sullivan marine galvanometer, it is by no means an easy task either to suspend or to balance quickly or efficiently the slide coil; and it has been with the object of simplifying both processes that the writer has developed a system which has now converted a hitherto rather anxious and difficult problem, not lightly undertaken even by expert manipulators, to a simple method within the powers of any submarine-cable electrician.

Electricity on the Farm.—The farm of Dolphingstone, Tranent, which was inspected recently by students attending Edinburgh University Department of Agriculture, has an up-to-date electrical installation. Power is obtained from the overhead line belonging to the local colliery company, which passes through the farm. The voltage is 3,000 a.c. and the supply is taken to a sub-station in the farm buildings by

means of an overhead cable, and is transformed there to 440 volts for power and 250 volts for lighting various buildings. All the farm machinery is driven by electricity, a 30-h.p. slip-ring motor being used for the thrashing mill, while the smaller machines are driven by a 5-h.p. motor of the squirrel-cage type. All the apparatus used on the farm is of British manufacture, and was installed by the Walker Electrical Service, Edinburgh, twelve months ago. The plant was described to the students by Mr. James Walker.

Novel Tower Wagon at Liverpool.—There has just been built at the Lambeth Road car sheds of the Liverpool Corporation a new type of tower wagon which has been built to travel alternatively on tramway track or ordinary road. At the present time the Corporation has about 12 miles of grass sleeper-laid high-speed track hedged off from the ordinary road, and new schemes are being proceeded with which will considerably increase this mileage. When this type of track was first used, one of the first difficulties was the supervision of the overhead equipment. When the ordinary tower wagon was run on to the soft ground the wheels sank, and manœuvring the vehicle became very difficult. After applying itself to the problem, the tramway department has now in service a new type of tower wagon which is equally service-



The New Liverpool Tower Wagon.

able for both road and track running. The vehicle illustrated above is believed to be the only one of its kind in service in this country. It was built by the Corporation staff, and a 45-h.p. A.E.C. engine is built in a Tilling-Stevens chassis. When the wagon is used for road service the ordinary rubber-tired wheels are engaged. When required for track service, hydraulic power is employed to effect a change-over, so that the weight of the wagon is borne by the steel track wheels, the rubber-tired road wheels being then elevated four inches from the ground. Power from the engine is transmitted through a cardan shaft to differential axles, secured to the driving wheels. An average speed of 11 m.p.h. is obtained on the track. The braking of the vehicle is by foot and hand levers operating band brakes on the driving wheels. This applies whether the vehicle is running on the road or track.

Appointments Vacant.—Meter tester and repairer for Aberdare U.D.C. Electricity and Tramway Department. Meter Room Assistant for the Stepney Borough Council electricity department; Clerk for the Borough of Southwark electric lighting station, Penrose Street; Laboratory Attendant and Instrument Repairer for the Polytechnic Engineering Laboratory; fourth engineer-in-charge (£349) for the Hammersmith Borough Council electricity department; Assistant mains engineer (£289) for the Cheltenham Corporation Electricity Department. The attention of intending applicants for the post of power house superintendent at Cheltenham, advertised in our last issue, is directed to the corrected announcement published to-day. (See our advertisement pages to-day.)

The Opening of the Ringwood Hydro-Electric Station.—At a time when the possibilities of developing the water power of this country are receiving serious consideration, the opening of the little hydro-station at Ringwood, Hampshire, is of particular interest. Colonel Wilfred Ashley, M.P., Minister of Transport, with Mrs. Ashley, ceremoniously opened the station on Friday, January 30th. In calling upon Mrs. Ashley to set the machines in motion, the Colonel said that although he hoped the river would continue to provide the excellent sport of trout fishing, "Father Avon" was now being called on to do some honest work.

At the celebration luncheon given by the chairman and directors of the Ringwood Electric Supply Co., Ltd., after the opening ceremony, Colonel Ashley referred to this as the electric age in which electricity would help reconstruction after the Great War as did steam after the Napoleonic Wars. He said that up to the outbreak of the war this country had not taken very kindly to electricity, other countries being well ahead of this in its use; but the war, with its insistent demand for munitions, doubled the output of electricity and brought home to the country the vital necessity of a cheap and abundant supply.

As soon as reorganisation after the war began, electricity came to the front, but if it was to maintain its position there must be a cheap and abundant supply. There were 541 electricity stations in this country, mostly small isolated stations, each with its own reserve of plant, and it was amazing to think that 68 per cent. of the total plant in the generating stations was standing idle. He did not wish to indulge in flights of fancy and he realised that some of the uses to which electricity had been put in other countries were not so feasible here, but there was immense room for expansion. The average consumption of electricity per head in Great Britain, taking all sources into consideration, was 200 units a year, in the United States 500 units, in Switzerland 700 units, and in Tasmania 550 units.

As Minister of Transport, he was responsible to Parliament for electrical matters and though it would be a long time yet before the full benefits of reorganisation would mature, rapid progress was being made. Since the Commissioners were entrusted with the duty of administering the Electricity Acts, that was to say, during the last five years, applications for Special Orders to authorise undertakings had been coming forward in a stream; Ringwood's application was the 132nd.

Colonel Ashley concluded by wishing the undertaking every success and a toast to that effect was given by Lt.-Col. E. G. St. Aubyn, D.S.O., and Mr. W. O. Rooper, M.Inst.C.E., M.I.E.E., the consulting engineer of the undertaking.

The Ringwood undertaking is the result of great local enterprise; the company promoters and directors are all local residents, and the capital has been raised locally.

Two 45-kVA a.c. generators, each driven by a 50-h.p. water turbine working under a 4-ft. head, are installed in the station.

Local Societies.—BEDFORD PHYSICAL AND RADIO SOCIETY.—The programme for February and March includes papers on "Faraday's Experimental Researches" (by Mr. P. Hudswell), "Resonance" (by Mr. G. West), and the "Electron Theory and the Classification of the Elements" (by Mr. H. Hvistendahl). Informal wireless demonstrations take place on the evenings of ordinary meetings. The hon. secretary is Mr. P. H. S. Kempton, B.Sc., 48, Goldington Avenue, Bedford.

THE LONDON COUNTY HALL.—Mr. Charles A. Baker, assistant engineer to the London County Council, read a paper on the electrical equipment of the London County Hall at a meeting of the Royal Society of Arts, on January 28th. The features of this interesting equipment have been described and illustrated in our pages. The building affords an outstanding example of the use of electrical energy in its numerous forms. Regarding the degree of illumination, an inquisitive member of the audience failed to appreciate why the members of the Council should be allowed 5.5 ft.-candles, whilst the staff were only given 3 ft.-candles or less. Sir George Hume, who has long been a member of the L.C.C. and was closely associated with its electric power bills, presided and spoke highly of the manner in which the work of electrically equipping the London County Hall was carried out direct by Mr. Baker without the intervention of contractors.

Electric Melting.—In the January *Bulletin* of the British Cast Iron Research Association a discussion is reported by the American Electrochemical Society, in which Dr. Moldenke shows the advantages of electric furnace melting to be ability to superheat, deoxidise and desulphurise the metal. The chief disadvantages are high cost and low tonnage, although first quality metal is produced.

Aldershot and Railway Supply.—At the annual meeting of the Aldershot Gas, Water & District Lighting Co., Mr. R. W. Edwards, chairman and managing director, complained of unjust competition through the seeking of Parliamentary powers by a group of London electrical undertakings for supplying energy to various railway companies for use upon their systems for any purpose incidental thereto. "Such powers," said Mr. Edwards, "would, of course, include the lighting and working of the numerous stations in this company's statutory area, and we were obliged to contest the point. The London power companies had promoted two Bills, and as a result of our objections a satisfactory safeguarding clause was incorporated in one of these Bills. The other has gone before Parliament without inclusion of such a clause, and we are, jointly with our friends and neighbours, the Woking Electricity Supply Co., presenting a petition to Parliament for the incorporation of a similar safeguard in the second Bill."

The Women's Engineering Society.—On January 31st, a party of members accompanied by members of the Women's Electrical Association paid a visit to the Hackney Borough Council's power station and refuse destructor. The visitors were conducted round the works by the chairman and vice-chairman of the Electricity Committee, and Mr. J. W. Beachamp (E.D.A.) was also in the party.

Electric Ophthalmia.—At the annual meeting of the Greenock Eye Infirmary, Dr. Gilchrist, ophthalmic surgeon, stated that among accidents it was noticeable that electric ophthalmia seemed to be on the increase. This resulted from the exposure of the eyes to a bright electric flash, and seemed to be due in great part to the predominance of the ultra-violet rays in the flash. The symptoms usually appeared some hours after the exposure. As the pain in the eyes increased the skin of the eyelids became swollen and red, similar to what was seen in severe sun burning, and tears gushed continuously. After one or two days the symptoms gradually subsided and there was no impairment of vision. The treatment of the condition was simple, but it was important to remember that those engaged with or near strong arc lights should have their eyes protected by smoked or coloured glass.

Institution Notes.

Institution of Electrical Engineers.—MERSEY AND NORTH WALES (LIVERPOOL) CENTRE.—On Friday last the annual dinner of the Centre was held at the University Club (Liverpool). Mr. H. H. Harrison, M.I.E.E., Chairman, presided, and the company numbered about 80 members and guests. Proposing the toast of "The City of Liverpool," Mr. F. GILL, past-president I.E.E., recalled the hospitable reception which the corporation gave the I.E.E. in 1923, and referred to the progressive spirit which characterised the city. Responding, the Lord Mayor, Alderman THOMAS DOWD, expressed his appreciation of the great benefits that the city derived from electricity in its many applications, which would be greatly extended in the future, and referred to the probable construction of a new tunnel under the Mersey.

The toast of "The Institution of Electrical Engineers" was proposed by Sir MAX MUSPRATT, who said the chemical industry was deeply interested in the cheap supply of electricity, which was essential to enable it to meet the competition of countries which had water-power at command. He laid stress on the importance of studying the use of pulverised fuel and other means of reducing the cost, and quoted with approval a suggestion that coal should first be used for the production of gas and afterwards the coke should be pulverised and burnt, thus utilising the coal to the best advantage. These problems should be worked out by co-operative action on the part of the great Institutions. Mr. Woodhouse had done splendid work in that direction before the war, but the increased cost of fuel had changed the position. Responding, Mr. W. B. WOODHOUSE, president I.E.E., said that Sir Max's views corresponded with those of the most advanced electrical engineers. The price of electricity in this country for all ordinary purposes compared favourably with prices abroad, but for the purposes of industrial chemistry mentioned by Sir Max, water-power had the advantage. By the erection of very large generating stations equipped with the most efficient plant, and the adoption of the utmost refinements to secure economy, together with the interconnection of these stations, it would be possible to offer the chemical industry electrical energy at prices that would compare with those resulting from the use of water-power. Complimenting the Centre on its increasing importance, the President said that the Institution was keeping pace with the growth of the industry; it was the largest and, he believed, the most important engineering institution in the country. Electrical engineers in the past had not realised the value of their work in an essential public service; but he hoped that municipalities and companies alike would accord them due recognition in the future.

Mr. H. DICKINSON proposed "Our Guests," offering a cordial welcome to the Lord Mayor and other eminent guests, and Mr. F. C. WILSON, chairman of the Liverpool Tramways and Electricity Committee, responded, claiming that electricity had attained to the stage of manhood, seeing that it was establishing itself in the home, and referring to the output of 150 million kWh recorded at Liverpool in 1924; the fuel consumption per kWh had been greatly reduced, and 25,000-kW turbo-generators were being installed.

Prof. E. W. MARCHANT proposed the health of the chairman, remarking that the Centre was strong on the "light-current" side of the industry, and that Liverpool contained one of the largest telephone factories in the country. Mr. HARRISON, in his response, reviewed the changes that had taken place in the electrical industry during the past 30 years, and paid a sincere tribute to the efficient services of the hon. secretary of the Centre, Mr. O. C. Waygood. A musical programme performed during the dinner and between the speeches added to the enjoyment of the evening.

INFORMAL MEETINGS.—On Monday, March 29th, there will be a discussion on the subject of "Illumination," to be opened by Mr. C. W. Sully.

At the informal meeting on January 26th, Mr. A. F. Harmer was in the chair, when Mr. S. W. Melsom opened a discussion on "The National Physical Laboratory and its Work." The greater part of Mr. Melsom's paper consisted of an absorbing account of the origin and growth of the laboratory with an outline of the many and very varied activities of its staff, which to-day numbers 400. Lantern slides showed views of the buildings and of the testing apparatus they contain. Mr. Melsom is of opinion that only the State can conduct research into many of the problems that have to be investigated to-day.

Mr. P. DUNSHEATH did not think that in industrial research the N.P.L. could compete with manufacturing concerns. In his own case, he found it impossible to finish investigations without testing conclusions in the factory, and it was there that the N.P.L. failed.

Mr. W. DAY thought the bulk of the work of the N.P.L. was not research, but high-class standardisation, and it did not entitle the workers to consider themselves superior beings. State and National Institutions were no spiritual home to men of original mind. Could they imagine Faraday or Heaviside within its confines? As an Institution provided by public money, would it and its resources be at the service of some genius employed by an industrial firm?

Mr. F. GILL said the laboratory had attained a status that ensured, when one saw a piece of paper with N.P.L. on it, the acceptance of its statements without question. The determination of some standards was a task that none but the financially strong could undertake; that was research of one kind. Industrial research, however, *must* be done by the manufacturer because he did not want the N.P.L. to have the knowledge and to carry it to his rival. In his own company they knew a stage as "development," a long step between research and selling, which investigated how to make commercially by the thousand yards or by the ton, work the N.P.L. could never do. Much research was very expensive, yet the chance of getting something from it depended entirely on how much one was going to spend.

Mr. J. R. Bedford, Mr. A. F. Harmer, Mr. C. L. Lipman, Mr. C. F. Phillips, Mr. E. S. Ritter, and Mr. H. T. Young also spoke, and Mr. Melsom replied.

SOUTH-MIDLAND CENTRE.—The recent Birmingham meeting, when Prof. G. W. O. Howe, D.Sc., M.I.E.E., James Watt Professor of Electrical Engineering, University of Glasgow, delivered the Faraday Lecture on "World-wide Radio Telegraphy," was a splendid success, and nearly 600 people were present, the attendance being the largest in the history of the Centre. The chair was taken by the Lord Mayor of Birmingham (Alderman P. Bower, J.P., O.B.E.), who was supported by Sir David Davis, ex-Lord Mayor of Birmingham, and all members of the Committee. Prof. Howe was exceeding well received, and had a tremendous ovation upon finishing his lecture. Previous to the lecture the Lord Mayor and Prof. Howe were entertained to dinner, and the Lord Mayor intimated that he would be pleased to afford hospitality to the Institution when it held its summer convention in the Birmingham area in June of this year.

Mr. E. B. WEDMORE, M.I.E.E., was elected a delegate member, representing the I.E.E., of the British Cast Iron Research Association on November 19th, 1924.

Junior Institution of Engineers.—POWER PLANT RECORDS.—In a paper read before the Junior Institution of Engineers on January 23rd, the author, Mr. R. H. Parsons, dealt with the relation between coal consumed and kilowatt-hours generated, or what is known as the "Parsons Line." He said that the study of this relation was the most direct way to economy, for once a standard had been fixed, any decrease or increase in efficiency was at once apparent; half the value of the line was its immediate availability for reference with its lesson apparent on the face of it. Instrument records were usually too indirect in their objects to cultivate a conscientious interest in their meanings on the part of the station staff, but if a particularly low point off the line was obtained for a shift, then the readings of the CO_2 and temperature recorders became of importance and interest. Mr. Parsons added that no records should be taken unless they were going to be the basis of some act. A point off the line showed when any act was necessary, unless the explanation was already known.

Mr. H. P. GAZO, in opening the discussion, said that there was no doubt of the value of the line for power station work, but he thought that for mixed plant the line might develop into a curve. Mr. Parsons would not agree. He said that if the points went above the straight line when certain plant was working, the line should be left where it was as an indication that the particular plant should not be used more than absolutely necessary. The readings should be recognised as bad ones. Mr. Gazo also said that, in spite of Mr. Parsons' remarks about instruments, every instrument had its use and value, and if they were used with intelligence one could not know too much about the plant.

Mr. J. H. GIBSON supported Mr. Parsons on the question of whether the line should be straight or curved in connection with plants of different consumption. He said also that Mr. Parsons's logic was very straight with regard to instruments. If the coal consumption was the best, then the CO_2 and flue gas temperature were the best possible. Indicating were better than recording instruments, for an accumulation of paper and data often brought the readings into contempt.

HIGH-PRESSURE TRANSMISSION.—At a meeting on January 30th, Mr. E. Ambrose delivered a lecturette entitled "Some Notes on High Voltage Transmission." The lecturette dealt only with the erection and laying of high-voltage lines overhead and underground, and contained many practical hints. Mr. Ambrose dealt with the laying of underground cables, and then spoke of overhead transmission, discussing the merits or disadvantages of various types of pole.

Institution of Mining Engineers.—The summer general meeting of the Institution will be held at Cardiff on June 16th to 19th next. The Council of the South Wales Institute of Engineers has offered to facilitate the arrangements for the meeting. The programme will include visits to collieries and works in South Wales.

A conference of available members of the Empire Council of Mining and Metallurgical Institutions was held in London, on December 29th, to discuss *informally* various questions bearing upon the constitution of the Council, and other matters. Representatives of the five home and of the Australasian, South African, and Indian constituent Institutions were present, and following the conference they were entertained at a farewell luncheon given by Mr. Frank Merricks, C.B.E. (past-president, Inst.M.M.), in honour of Mr. Herbert W. Gepp (president of the Australasian Institute), on the eve of his departure for Australia.

Royal Institution.—At a general meeting of the Royal Institution on February 2nd, the special thanks of the members were returned to Captain H. Leoffler, M.R.I., for his generous gift of a collection of valuable electrical apparatus.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

MR. J. O. NICHOL, B.Sc., has removed to 23, King Street West, Manchester.

MR. F. R. UNWIN, A.M.I.E.E., this year's President of the Birmingham Electric Club, which is celebrating its coming-of-age, received his workshop training with Messrs. Crompton and Co., Ltd., at Chelmsford, proceeding subsequently to the B.T.H. Co., Ltd., Rugby, where he was engaged in the test departments and motor design department. He then completed his technical education at the Central Technical College, South Kensington, afterwards joining the staff of the English branch of the A.E.G. Following seven years in the Territorial Force, he reported for duty with the Forces in November, 1914, serving with the Royal Engineers on the Western Front and commanding the 642nd Field Company Royal Engineers on demobilisation in July, 1919. Since this period he has been engaged with the General Electric Co., Ltd. Mr. Unwin delivered his address, to which we refer briefly on another page, on January 23rd.

The London County Council Highways Committee recommends that Mr. E. W. DICKINSON, power station engineer at the Greenwich power station, be retired as from February 28th, 1925. The General Purposes Committee has considered the question of granting a retiring allowance to Mr. Dickinson, and recommends that he be granted a retiring allowance of £200 a year.

MR. R. H. PARSONS has resigned his position on the staff of *Engineering*.

The Ilford Electricity Committee recommends that as and from April 1st next, the Council adopt the scale of salary of the Incorporated Municipal Electrical Association for Chief Electrical Engineers, and that Mr. A. H. SHAW, electrical engineer and manager, be placed upon the minimum of the scale, *viz.*, £997 10s., the scale being based upon the estimated number of kWh sold for the current financial year. (Present salary £942 10s., including bonus.) The Council has decided to refer the matter to a special committee.

MR. CHARLES MITCHELL, of Arbroath, has been appointed charge engineer at Riverside power station, Shanghai.

MAJOR F. COUTTS has been appointed manager of the Wakefield and District Tramways, and is to be succeeded as manager of the Dearne District Tramways by his son, Mr. Ronald Coutts, who has been acting as engineer and deputy manager.

MR. ARTHUR SMITH, partner in Messrs. Dean, Smith and Grace, Keighley, has been elected chairman of the Keighley Corporation Tramways Committee, in succession to Alderman F. L. Smith, who has resigned on removing to Skipton.

Burton-on-Trent Town Council has increased the salary of the electrical engineer and tramway engineer, Mr. T. HALL, by £100 to £1,000, inclusive of any bonus. The salary of the tramway manager, Mr. A. B. SLATER, has been increased by £50 a year to £525.

MR. F. J. FROST, who has for 12 years been Traffic Superintendent of the Kent Telephone District, has been appointed to a similar post at Exeter. He has been connected with the telephone service since 1889.

MR. W. W. CLARK, engineer and manager of the Luton Corporation Tramways, who is leaving to take up an appointment at Nottingham, has been presented with an oak Jacobean clock by the trackmen and shedworkers.

Grimsby Town Council has appointed Mr. J. C. WHITELEY, of South Shields, as manager of the tramways at a salary of £650 per annum.

Through an error on the part of a correspondent, in our last issue we stated that the salary of the Wolverhampton Corporation Tramways Manager, Mr. C. O. SILVERS, had been increased to £850 per annum, whereas the last increase was made five years ago. We very much regret the mistake.

MR. WILLIAM PRESTON, who was returned as M.P. for Walsall at the last election, has lost his seat owing to a legal technality, but he is standing again as Unionist candidate in the consequent by-election. As head of the firm of W. Sanders and Co., of Wednesbury, Mr. Preston was for many years a contractor for the supply of electrical fittings to the Post Office Stores Department, and at the time of his adoption as Unionist candidate he had two small contracts in hand.

The Middlesbrough Corporation General Purposes Committee has sanctioned the raising of the salary of the electrical engineer (Mr. R. H. SCOTSON) to £750 by restoring the £91 which was deducted some time ago.

Rotherham Town Council has decided to increase the salary of the tramway manager, Mr. T. P. SYKES, by £100 a year.

The Chester Tramways Committee has recommended the increasing of the salary of the tramway manager from £375 to £400 per annum with house, coal and lighting. Increases are also proposed for other officials of the department.

Mr. ALBERT CONNOR, of Bolton, for four years transport superintendent to the Rawtenstall Corporation, has been appointed to a similar position at Dewsbury from over 100 applicants.

It is announced that Sir ERIC GEDDES, who has been president of the Federation of British Industries for the last two years, is retiring from the office at the end of his present term.

MR. N. DONKERSLEY, A.M.I.E.E., late charge engineer with the Huddersfield Tramway Supply Undertaking has been appointed to a post with Messrs. Millers, of Brighouse. Last Saturday he was presented with a case of cutlery and a book rack by the staff and employés of the department.

Obituary.—MR. H. W. SULLIVAN.—We record with feelings of deep regret the death of Mr. Herbert Watson Sullivan, M.I.E.E., the well-known electrical engineer and instrument maker. The staff dinner of H. W. Sullivan, Ltd., electrical, telegraph and radio engineers, London, was to have been held last week, but on the morning of his death, January 28th, notice was circulated that, owing to Mr. Sullivan's illness it had had to be indefinitely postponed. He passed away later on the same day at 202, Bedford Hill, Balham, in his 70th year. The funeral took place on Tuesday morning. We hope to publish an account of Mr. Sullivan's career in our next issue.

MR. C. H. WORDINGHAM.—At the funeral of Mr. C. H. Wordingham at Twickenham on January 31st, the Institution of Electrical Engineers was represented by :—Mr. Ll. B. Atkinson (in the unavoidable absence of the President, Mr. W. B. Woodhouse), Mr. F. Gill, Mr. J. S. Highfield, Dr. A. Russell, F.R.S., Mr. C. P. Sparks, C.B.E., Mr. F. W. Crawter, Mr. S.W. Melsom, Mr. P. Rosling, Mr. E. H. Shaughnessy, O.B.E., and Mr. P. F. Rowell, secretary. Various other bodies were represented by Mr. W. McClelland and Mr. R. R. Scott (Admiralty); Mr. C. Rodgers (B.E.A.M.A.); Mr. P. Good and Mr. Chas. Dresser (B.E.S.A.); Mr. L. G. Tate (E.C.A.); Mr. W. W. Lackie and Mr. A. Page (Electricity Commission); Mr. L. Gaster (Illuminating Engineering Society); Dr. A. Russell, F.R.S., and Mr. H. G. Riddle (J.I.E.); Dean Matthews, Prof. Gilbert Cook, and Prof. Ernest Wilson (King's College); Brig.-Gen. M. Mowat, C.B.E., and Mr. James Parkins (K.C.O.S.A.); Mr. F. A. Greene (O.S.A., Engineering Branch); Mr. S. W. Melsom (N.P.L.); Mr. O. Pearston (ELECTRICAL REVIEW); Mr. Wordingham's London staff, Mr. C. E. Sayer, Capt. A. Sproull, Miss Spaeth, and Miss Boult; and his Manchester staff, Mr. R. W. Willis and Mr. J. P. Thornton. In addition to Mrs. Wordingham, the following also attended :—Mr. G. L. Addenbrooke, Mr. and Mrs. R. B. Anderson, Mr. J. E. Kingsbury, Mr. and Mrs. Leach, Mr. E. T. Ruthven Murray, Mr. A. M. Sillar, Mr. C. Thornton, Mr. J. M. G. Trezise, Mr. W. E. Wordingham, Mr. W. H. D. Wordingham, and Mr. W. Wyld.

MR. W. L. MADGEN.—We regret to have to record the death of another pioneer of the electrical industries in Mr. W. L. Madgen, M.I.E.E., who died on Friday last, January 30th, at his residence, 11, Abbey Road, St. John's Wood, London. Mr. Madgen, who had been a director of the Electrical Press, Ltd., since 1901, was born at Haltwistle, Northumberland, in 1861. He was educated at Bedford, and afterwards entered the School of Electrical Engineering in Hanover Square, out of which he passed in 1879 to take up an appointment with the National Telephone Co., and he was engaged upon the equipment of the first telephone exchanges in Glasgow, Belfast, Leeds, and Bristol. He left the telephone service in 1883, and for three years was engaged with Messrs. Woodhouse and Rawson in general electric work. In 1886 Mr. Madgen joined in the purchase of a half interest in the Jablochkoff Co., which was merged later into the late United and Electrical Engineering Co.

Mr. Madgen was for some years with Messrs. Ferranti, Ltd., and he was also connected with the late Mr. H. Reason and

The late Mr. W. L. Madgen.

Mr. A. Wright in the development of their factory at Brighton. In 1898 he became managing director of the Electrical Power Distribution Co., and in 1902 took up a similar position with the Brush Electrical Engineering Co., Ltd.

Mr. Madgen underwent a serious illness in July, 1921, since when he had never recovered his normal health. At the time of his illness he was interested in the British Electrical Federation, Ltd., and in many of its associated tramways and electrical undertakings.

A very large number of friends will miss in Mr. Madgen a man of genial manner, strong personality, and great energy. The funeral took place at Brookwood Cemetery on Tuesday, February 3rd. Mr. Madgen was 63 years of age.

New Companies Registered.

Asbestos Manufacturers' Co., Ltd. (203,383).—Private company. Registered January 26th. Capital, £1,000 in £1 shares. To carry on in the United Kingdom and elsewhere the business of manufacturers of, and dealers in asbestos or any articles, apparatus or goods made from asbestos or any other fireproof substance, including asbestos fibres, crude and manufactured asbestos, non-conducting coverings, hair felt coverings, lagging and braidings, engine and pump packings and joints for steam, air, oil and water, india rubber packings and high-pressure steam jointing, india rubber sheeting and insertion, vulcanised fibre and eluonite, machine belting in cotton, balata, hair, india rubber, and leather, leather belting and laces, asbestos brake linings and sheetings, india rubber valves and goods of all kinds, asbestos slates, tiles, roofing and lining, asbestos insulating and building materials, &c. The permanent directors are :—J. S. Grimason, 79a, Denmark Villas, Hove, merchant; and L. L. Mortlock, "Rosebank," 139, Overhill Road, Dulwich, S.E.22. Solicitors: Benham, Synnott & Wade, Suffolk House, Laurence Pountney Hill, E.C. Registered office: 36, Victoria Street, Westminster, S.W.1.

Phonotas (Scotland), Ltd. (23,483).—Private company. Registered in Edinburgh January 22nd. Capital, £2,500 in £1 shares. To carry on the business of cleansing and disinfecting telephones, telephone apparatus, and other instruments, &c. The first directors are :—W. C. Hendry, 219, Queen's Road, Aberdeen, retired insurance manager; L. C. Becker, 31, Castelnau Gardens, Barnes, London, S.W.13., assistant manager of Phonotas Co. Ltd. Registered office: 116, St. Vincent Street, Glasgow.

Electric Refrigeration Co., Ltd. (203,370).—Private company. Registered January 26th. Capital, £100 in £1 shares. To acquire from R. R. Richardson and others (if any) all or any of his or their rights in an invention relating to improvements in pumps for refrigerating machines and otherwise in respect of which British letters patent No. 219,899 of 1924, and certain foreign letters patent have been granted, and to carry on the business of manufacturers of, agents for, and dealers in all kinds of refrigerators, refrigerating plant, machinery, and apparatus, &c. The subscribers (each with one share) are :—T. E. Samuels, 22, Westcliff Park Drive, Westcliff-on-Sea, Essex, contractor; J. Dixon, 56, Victoria Street, S.W.1. secretary. R. R. Richardson is to be one of the first directors. Registered office: 7, Cavendish Mansions, Langham Street, W.1.

West Witton Electric Supply Co., Ltd. (203,351).—Private company. Registered January 24th. Capital, £1,000 in £1 shares. To carry on the business as indicated by the title. The first directors are :—P. H. Fletcher, "Bolton View," Bolton Road, Bradford, maker-up and packer; Miss A. Close, West Witton, Leyburn, Yorks.; S. Cottingham, West Witton, Leyburn, Yorks., farmer; L. Mason, West Witton, Leyburn, Yorks., farmer; J. C. Smorthwaite, West Witton, Leyburn, Yorks., saddler. Qualification, £25. Remuneration as fixed by the company. Secretary: J. C. Smorthwaite. Solicitor: J. Conchar, 9, Duke Street, Bradford. Registered office: West Witton, Leyburn, Yorks.

David J. Patton, Ltd. (203,402).—Private company. Registered January 27th. Capital, £5,000 in £1 shares. To acquire the business of a manufacturer of, and dealer in electrical sundries carried on by David J. Patton at 43, Johnson Street, Westminster. The permanent directors are :—D. J. Patton, 47, Calais Gate, Camberwell S.E.5, manufacturer; S. Brookes, 8, Calais Gate, Camberwell, S.E.5, manufacturer; W. J. Deeley, 42, Calais Gate, Camberwell, S.E.5, manufacturer. Qualification, £100.

Radio Maritime, Ltd. (203,429).—Private company. Registered January 28th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of, and dealers in wireless and other telegraph and telephone apparatus, to acquire any land or buildings for the purpose of conducting schools for the training of wireless operators, to enter into contracts with and employ wireless and other telegraph or wireless telephone operators, to supply, erect, maintain, and repair wireless and other telegraph or wireless and other telephone apparatus or installations either on board ships or on land in any part of the world, &c. The first directors are :—E. R. Tuck, 17, High Street, Harrow-on-the-Hill, Middlesex (managing director of Radio Clubs, Ltd., and general secretary and treasurer of the Association of Wireless and Cable Telegraphists); T. J. O'Donnell, 19, Highbury Grove, N.5 (director of Radio Clubs, Ltd., and marine secretary of the Association of Wireless and Cable Telegraphists). Registered office: Lennox House, Norfolk Street, Strand, W.C.

Gibrico Electric, Ltd. (203,421.—Private company. Registered January 28th. Capital, £1,000 in £1 shares. To carry on the business of electricians, engineers, manufacturers of, and dealers in wireless apparatus and accessories, mechanical and electrical toys, gramophones, records, and apparatus, &c.. The subscribers (each with one share) are :—H. W. Gibbs, 1, Mountfort House, Barnsbury Square, N.1, dyer of fabrics; E. E. Bridger, 57, Halton Mansions, Canonbury, N.1, electrical and mechanical engineer; R. Collings, 1, South Street, Islington, N.1, dispensing chemist. The first directors are to be appointed by the subscribers. Qualification, 100 shares. Remuneration, as fixed by the company. Solicitors: Wood and Sons, 1, St. Andrew's Hill, Carter Lane, E.C.4.

Weald Electricity Supply Co., Ltd. (203,492). — Registered as a "public" company on January 30th with a nominal capital of £40,000 in £1 shares. The objects are :—To adopt an agreement with Callender's Share and Investment Trust, Ltd., and to carry on the business of electricians, mechanical engineers and manufacturers, workers of, and dealers in electricity, motive power and light, &c. The subscribers (each with one share) are :—Sir Thomas O. Callender, Bedborough Court, Kent, electrical engineer; P. V. Hunter, 102, Foxley Lane, Purley, electrical engineer; B. J. Day, Elm Hill, Hawkhurst, Kent, consulting engineer; J. V. Foulds, "Littlecombe," Caterham Valley, chartered secretary; J. P. Loosemore, 27, Gorst Road, Wandsworth Common, S.W.11. cashier; A. L. Lee, "The Briars," Groombridge, Tunbridge Wells, accountant; C. W. Clarke, 18, Nightingale Square, S.W.12, chartered secretary. The first directors are not named. Minimum cash subscription, 7 shares. Qualification, £500. Remuneration (except managing director), £100 each per annum (chairman £150), and 5 per cent. of the net profits when not less than 6 per cent. dividend is paid on the ordinary shares, divided between them. Solicitors: Murton, Clarke & Murton-Neale, Cranbrook, Kent. The Registered office is at 66, The Pantiles, Tunbridge Wells.

Official Returns of Electrical Companies.

Whitstable Electric Co., Ltd.—Issue on January 16th, 1925, of £1,000 debentures, part of a series already registered.

C. F. Casella & Co., Ltd.—Satisfaction in full on January 1st, 1925, of mortgage debentures dated April 4th, 1910, and January 5th, March 31st, May 19th, August 28th, and December 15th, 1911, securing £2,000.

Simms Motor Units (1920), Ltd.—Satisfaction to the extent of £5,000 on December 31st, 1924, of debentures covered by trust deed dated March 31st, 1921, securing £40,000.

Van Raden & Co., Ltd. (78,383).—Return dated December 15th, 1924. Capital, £10,000 in £1 shares. 6,754 shares taken up, £4,654 paid. £2,100 considered as paid. Mortgages and charges: Mortgage, £1,800; debenture, £1,200; loan, £4,000.

City Notes.

Yorkshire Electric Power Co.

The report of the directors in respect of the year ended December 31st, 1924, states that the net profit, after the payment of interest and debenture stock discount charges, was £182,764, as compared with £130,054 in 1923. To this is added £34,640 brought forward, making £217,404 (£156,593).

The directors recommend the payment of a dividend of 6 per cent. (3 per cent. already paid) on the cumulative preference capital, absorbing £38,595; a dividend of 8 per cent. (3 per cent. already paid) on the ordinary capital, requiring £67,755; the transfer of £40,000 to the general reserve, making it £194,000; and the establishment of a plant renewals fund with £25,000; leaving a balance of £46,053 to be carried forward.

The report states that notwithstanding the general adverse trade conditions there has been more electricity sold, including a satisfactory increase in bulk supplies to authorised distributors. During the year agreements were made for supplies to the Urban District Councils of Normanton and Slaithwaite, and to the Dearne District Electricity Board and the Dearne District Light Railways Joint Committee. The Electrical Distribution of Yorkshire, Ltd., obtained orders for Burley-in-Wharfedale and district, Gildersome and district, Guiseley and Yeadon, Kirkheaton and district, Mytholmroyd, Colne Valley and district, and South Yorkshire. Under the agreement between the companies the Power Co. will furnish a supply for these areas.

Large extensions of mains have been made and many new sub-stations erected to meet the requirements of old and new customers, and further extensions have been made at the Thornhill and Barugh stations which have resulted in increased output and economy of production. The erection of the Ferrybridge power station is proceeding, and contracts have been let for the greater part of the buildings and plant.

The extensions made and developments in progress and in prospect necessitate the provision of further capital. Accordingly, after the general meeting (Leeds, February 10th) an extraordinary meeting will be held to secure sanction to the immediate issue of £500,000 in ordinary shares, to be followed as and when required by £773,000 either in ordinary or preference shares.

The directors express their regret at the rejection by the House of Lords Committee of the Bill promoted by the company in respect of the re-organisation of supply in the West Riding (Aire and Calder) Electricity District. At the suggestion of the Electricity Commissioners, the company and the principal suppliers of electricity in the district are considering whether the scheme cannot still be carried out satisfactorily by agreements between the various parties supplemented by an Order of the Commissioners.

Mr. W. G. Jackson has resigned his seat on the board.

East London Railway Co.

The annual meeting was held on January 29th, Mr. Murray Griffith presiding. After a sympathetic reference to the death of the company's chairman, Lord Claud Hamilton, Mr. Griffith said that, in common with other railways, their system had greatly benefited from the British Empire Exhibition. Their line was a small one, and depended a great deal upon the good will and helpfulness of their neighbour, the Southern Railway. The electrification of the latter would probably result in less traffic for the East London line—although the reverse was possible. In the circumstances the Board considered that the offer of the Southern Railway to purchase the system should be accepted. The stockholders of the company would receive in exchange for their holdings a stock that would be an immediate producer of dividends. The proposals would be submitted for approval at a meeting to be held on February 17th. Mr. V. Olson expressed the disappointment which the proposed terms had given to many of the debenture- and stockholders. He asked if another better offer had not been made previously. No allowance had been made for the fact that the Southern Railway Co. would be able to raise the fares by 75 per cent. Again, what consideration had been given to the large Surrey Commercial Docks extensions?

A number of stockholders expressed their approval of the scheme. In reply, the chairman said that there had been a previous offer, but the present one was considered better. No increase of fares was allowed on leased lines. The question of the Surrey Docks was out of their hands, as the line was leased in perpetuity to a joint committee. The third, fourth, and consolidated stockholders would certainly benefit from the scheme. The report and accounts were adopted.

Yorkshire (West Riding) Electric Tramways Co., Ltd.

Sir Herbert S. Leon, Bart., presided at the annual meeting of the company on January 30th, and in the course of his speech said that the company was working under many difficulties. One of these was the expiry of the company's Temporary Increase of Charges Order in March last. Unless this was extended they would have to face a loss of from £18,000 to £20,000 per annum. Another adverse factor was the increasing motor omnibus competition which had resulted in a fall of £9,600 in the company's traffic receipts. Their own motor services, which were inaugurated in 1922, were successful, but it was unwise to make definite statements as to their future.

A shareholder gave it as his opinion that a larger dividend

ould have been paid, while another objected to the policy of the Board in investing the profits of the company in the business instead of raising fresh capital. The latter asked the Board for an undertaking that no further capital would be issued by the Automobile Company bearing a higher interest than 7 per cent., except to the Tramway Company, without the approval of the shareholders of the latter company. The Chairman said that he had no hesitation in giving that undertaking.

A motion to adjourn the meeting was carried, but upon the taking of a poll this was negatived and the report and accounts were adopted.

Lanarkshire Tramways Co. The accounts for the year ended December 31st last show a revenue of £212,845 and expenses of £160,736, and after the payment of debenture interest, &c., and transferring £17,500 to reserve there is a balance of £26,150, to which is added £2,073 brought forward, making £28,223. The interim dividend absorbed £13,081; a final dividend of 6 per cent. (making 6¼ per cent. for the year) requires £11,212; and a balance of £3,930 is carried forward subject to additional remuneration to the directors. The report states that the expenses increased to a greater extent than the revenue, and that the motor omnibus services have been greatly extended and further routes are to be opened. The meeting is to be held on February 9th.

Italian Companies. The *Unione Telefonica Italiana*, of Milan, has closed its working year to September 30th last with a net profit of 1,327,454 lire. A dividend of 20 lire per 10 lire share was distributed. Its capital is 500,000 lire.

The *Società Elettricità Alta Italia*, of Turin, has decided to raise its capital from 125,000,000 to 250,000,000 lire by the issue of 500,000 shares of 250 lire each. The issue will be made in two parts, the first part immediately and the second in 1927.

The capital of 5,000,000 lire of the Milan *Imprese Elettriche dell'America Latina* is to be raised to 10,000,000 lire.

The *Società Italiana Metallurgica Elettrolittica*, of Milan, has raised its capital from 50,000 lire to 4,150,000 lire.

An extraordinary meeting of the *Società Anonima Energie Elettriche Valle Seriana* has sanctioned the increase of the company's capital from 2,000,000 to 6,000,000 lire.

The proposed capital increase of the *Unione Esercizi Elettrici*, of Milan, has received the shareholders' sanction. An issue will be made of 600,000 new shares of 50 lire nominal at the price of 100. 70,000 of these shares will be ceded to the Società Idroelettrica dell'Ossola.

New Capital Issues.—*United River Plate Telephone Co., Ltd.*—The directors have offered to the shareholders an issue of 108,000 ordinary shares of £5 each at par, in the proportion of one to every six shares at present held. A further 4,000 shares are being reserved for subscription by the staff. The shares will rank for dividend as fully-paid from January 1st, 1925.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—An issue of 465,000 ordinary shares of £1 each at par was offered to existing shareholders, in the first instance, last week. The new shares will rank *pari passu* with the existing ordinary shares in respect of the current year's dividend, but not for the final dividend for 1924, which has yet to be declared. The new issue bring the company's share capital up to approximately £4¾ million, apart from debenture capital amounting to over £3 million.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

United River Plate Telephone Co.—112,000 new ordinary shares of £5 each issued at par, partly and fully paid, Nos. 648,001 to 760 000.

Ascot District Gas and Electricity.—3,366 new 6 per cent. preference shares of £10 each, fully paid, Nos. 10,501 to 13,866.

The undermentioned have been ordered to be officially quoted:—

American Telephone and Telegraph.—$7,007,000 capital stock.

Traction and Power Securities.—£300,000 4½ per cent. debenture stock.

Metropolitan Railway Co.—A final dividend of 3 per cent. has been declared upon the ordinary stock, making 5 per cent. for the year. £25,000 is transferred to the general reserve and about £51,000 carried forward. The dividend for 1923 was 4 per cent., the transfer to reserve was £15,000, and £35,250 was carried forward.

Westminster Electric Supply Corporation, Ltd.—A final dividend of 7s. per share and a bonus of 3s. have been declared upon the ordinary shares, making the total dividend for 1924 15 per cent. as in the previous year.

City of Buenos Ayres Tramways Co. (1904), Ltd.—A final dividend of 1s. 3d. per share has been declared for 1924, making 5 per cent. £5,000 is to be transferred to the general amortization fund, and £11,439 carried forward.

Northern Mexico Power and Development Co.—A dividend of 7 per cent. has been declared on the preference shares in respect of the amount accrued to January 1st, 1923.

Swiss Company.—The *Société Financière pour Entreprises Électriques aux Etats Unis*, of Geneva, is increasing its capital from 10 to 15 million fr.

Clontarf and Hill of Howth Electric Tramroad Co.—The company has declared a dividend of 3 per cent., with 1s. per share bonus, the carry forward being £170.

Ferguson, Pailin, Ltd.—CORRECTION.—In our last issue our report of the company's meeting contained an incorrect statement as to the dividends paid. The ordinary shares received 13 per cent. for the year and the preference shares 8 per cent.

Stocks and Shares.

MONDAY EVENING.

CONDITIONS in the Stock Exchange markets are not widely different from those of the last week in January, when business fell away to a noticeable extent, the spirit of speculation giving place to a more cautious sentiment throughout the House as a whole. This week has seen the first February settlement, which has proved a humdrum affair compared with last account, but which, also, has its own particular difficulties to be surmounted. Once more there will be a certain relief felt when the account is over, and business is able to go ahead untrammelled by financial apprehension. Budget talk is starting well in advance of the new Chancellor's maiden effort, but although anticipation looks for a reduction in the Income Tax, this hopefulness is exercising no effect upon Stock Exchange prices, possibly because it is tempered with a certain absence of enthusiasm. Home Electricity Supply shares keep good. Home Rails show heaviness, sequel to the vague gossip of labour intransigence on the big lines.

Bournemouth and Poole ordinary at 2 11/16 are 2s. 6d. higher, and the new shares at 52s. 6d. are correspondingly strong. Charing Cross lost their small gain of last week. Westminsters at 11 7/16 are unchanged on the declaration of a dividend making 15 per cent. for the year, the same rate as that declared for 1923. The announcement came as something of a disappointment. It is the prelude, of course, to the other results to be announced by the London companies, some this week, and most within the course of the next fortnight or so. People have been looking for last year's dividends to be increased, but the Westminster declaration tends to modify previous hopes. There is an idea now, that the companies will make no particular effort to improve upon their excellent dividends of a year ago. A rise of 7s. 6d. in St. James' and Pall Mall suggests that the results will flatter the holders of the shares.

Midland Counties Electric Supply shares strengthened to 24s. 3d. on attention being called to the remarkably progressive manner in which the company is gaining ground. Last year's dividend was 5½ per cent. and the declaration in respect of 1924, which is now due, may be 6 per cent. or 6¼ per cent. Present yield is less a matter for consideration with to-day's buyers than the possibilities which open before the company in the future, for its sales of energy have been going up by leaps and bounds; and, since 1915, when 5½ million kWh was sold, the output has risen to 31¾ million kWh in 1923. Yorkshire Electrics have gained 2s. at 31s., and the company's preference shares are harder at 23s. 6d.

The Newcastle-on-Tyne Company maintains its dividend of 8 per cent., and a fresh issue of ordinary shares is to be made at par, that is, 20s. The price of the existing shares is 22s. middle, and the new shares are quoted at about 6d. premium, the proportion being one new for every 4 shares at present held. The price of the old was quoted ex rights on Monday.

Home Railway stocks are dull, with falls in Metropolitans, Underground Ordinary and Districts. The Metropolitan Company's dividend, making 5 per cent. for the year, merely met expectations, and it is considered doubtful whether the District will, on the Thursday in this week, declare more than a previously-paid 3½ per cent. The Underground Company is not expected to pay anything on its ordinary shares. The Income Bonds remain steady at 101. British Electric Tractions are better at 100½ and the preference stock at 106½ is also a point to the good. Mexican Light & Power preferred put on 7½ points, reaching 60. Brazilian Tractions have strengthened, and Anglo-Argentine Tramways hold their recent gains.

United River Plate Telephones at 6¾ are ex the rights to the new shares recently issued. The price of the latter is quoted at 1¾ premium, one new share being offered in respect of every six ordinary held, the subscription price being £5 per share. In addition to the 108,000 ordinary shares for the proprietors, 4,000 additional shares are reserved for subscription by the staff.

Chile Telephones show a rise of ¼ at 8¼, and Automatics are better at 30s. The Eastern Cable group shows a slightly better tendency. Eastern Extensions at 17½ are ¾ up and Eastern ordinary, after going back to 171, recovered to 172¼.

Prices of manufacturing shares are fairly well maintained, though Electric Constructions at 32s. 6d. have lost a florin. Siemens are easier at 23s. 9d. General Electrics drooped to 22s. 9d. Enfield ordinary further improved to 51s. 3d. Cromptons at 13s. 9d. have put on 1/16, while Telegraph Constructions at 27 show a rise of 10s., reflecting the anticipation of an increase in the dividend. Engineering shares are disposed to be a little easier, Babcock losing 9d. at 2¼. The iron and steel market is under the harrow of fears lest there may be strikes in the railway and in the coal industries.

The rubber market is better, though the public is taking little practical interest in the price of shares. Business, indeed, is quiet, as already noted, in most parts of the Stock Exchange, where members are looking round to discern if they can what factors are likely to prove of service in galvanising fresh interest in their markets.

Inquiry reaches us as to why the yield on Edmundson's ordinary was not worked out in the final column of our tables. The answer is that the company's capital account was reorganised not long ago, and it might be considered, austerely, incorrect to quote the then-paid 7 per cent. as the dividend on the new ordinary. Nevertheless, the point shall be willingly conceded that it is reasonable to work out a yield as the dividend is already given in the third column of the tables, and the suggested addition has therefore been made.

Share List of Electrical Companies.

	Nom.	Dividend. 1922.	Dividend. 1925.	Price Feb. 2. 1924.	Rise or fall.	Yield. p.c.
HOME ELECTRICITY COMPANIES.	£					
Bournemouth and Poole ...	1	10	13	2¼	+ ⅛	4 16 8
Brompton Ordinary	1	12	10	1⅝	—	*5 6 8
Charing Cross Ordinary	1	14	14½	46/3	—9d.	6 5 7
do. do. do. 4½ Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	10	12	37/6	—	6 8 0
City of London	1	15	15	49/6	—	6 1 0
do. do. 6% Pref. ...	1	6	6	23/6	—	5 2 2
Clyde Valley	1	8	8	28/-	—	5 14 4
County of London	1	10	15	53/3	—	5 14 1
do. do. 6% Pref. ...	1	6	6	23/6	—	5 2 2
Edmundson's Ordinary	1	7	7	22/-xd	—	6 7 3
do. 7% Pref.	1	6	6	22/6	—	6 4 5
Elec. Supply Corporation ...	1	8	10	27/-	—	7 8 2
Kensington Ordinary	5	12	14	11½	—	6 4 5
Lancs. Light and Power ...	1	Nil	7½	27/-	+1/-	5 11 1
London Electric	1	10	10	35/6	—	5 12 8
do. do. 6% Pref. ...	5	6	6	5¾	—	5 9 1
Metropolitan	1	8½	10	1⅞	—	5 6 8
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	5	5½	24/3	+6d.	4 10 7
Newcastle-on-Tyne Ordinary ...	1	2½	6	1⅛	—	5 6 8
do. 5% Pref. ...	1	5	5	18/9	—	5 6 8
do. 7% Pref. ...	1	7	7	25/-	—	5 12 0
Notting Hill 6% Pref.	10	6	6	9¾	—	6 4 5
North Met. Elec. 6% Pref. ...	1	6	6	1⅛	—	5 6 8
Urban Ordinary	1	—	4	12/9	—6d.	4 5 4
do. 6% Pref. ...	1	5	6	19/6	—	6 3 1
St. James' and Pall Mall ...	5	14½	17½	13½	+ ⅝	6 12 0
South London	1	11	15	2⅞	—	6 3 0
South Metropolitan Pref. ...		7	7	1½	—	5 12 0
Westminster Ordinary	5	12	15	11⅞	—	6 11 0
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	1	—	7 10 0
Yorkshire Elec.	1	8	8	31/-	+2/-	5 3 4
HOME RAILS.						
Central London Ord. Assented Stock		4	4	74	—	5 8 1
Metropolitan ... ... ,,		3½	4	79	—1	6 6 7
do. District ... ... ,,			3½	54½	—1	6 8 8
Underground Electric Ordinary	10	Nil	Nil	3	— ¼	Nil
do. do. "A" ...	1	Nil	Nil	10/-	—	Nil
do. do. Income	Bonds		6	101	—	*5 18 10
TELEGRAPHS AND TELEPHONES.						
Anglo-Am. Tel. Pref.	Stock	6	6	104	—	5 15 5
do. Def. ... ... ,,		1½	1½	23½	—	6 7 8
Automatic Telephone	1	Nil	3	1½	+ ⅛	2 0 0
Chili Telephone	5	6	6	8½	+ ½	*5 4 4
Cuba Sub. Ord.	10	7	7	7	—	10 0 0
Eastern Extension	10	10	10	17½	+ ½	*5 18 0
Eastern Tel. Ord.	Stock	10	10	173½	—	*5 16 0
Globe Tel. and T. Ord.	10	10	10	17½	—	*5 16 0
do. do. Pref.	10	6	6	11½	—	5 7 10
Great Northern Tel.	10	24	22	30	—	7 6 8
Indo-European	25	7	7	32½	—	*5 6 1
Marconi	1	15	10	1¾	—	5 14 3
Marconi Marine	1	10	10	1⅛	—	8 17 10
Oriental Telephone Ord. ...	1	12	12	1⅞	—	*6 8 0
United R. Plate Tel.	5	8	8	6¾xr	—	*6 0 9
Western Telegraph		10	10	17	—	*5 17 8
HOME AND FOREIGN TRAMS, &C.						
Anglo-Arg. Trams First Pref. ...	5	12½	5½	3½	—	8 9 2
do. do. 2nd Pref. ...	5	5½	6	3	—	10 0 0
do. do. 5% Deb. ...	Stock	5	5	75½	—	6 12 5
British Electric Traction Ord. ...	,,	5	6	100½	+1	5 19 6
do. do. 6% Pref. ...	,,	6	6	106½	+1	5 14 9
Brazil Traction	100	4	4	59	+1	6 15 7
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	89½	+1	5 11 9
do. do. Preferred	,,,	5	95/-	89½	+1	*5 7 2
do. do. Deferred	,,	8	129/6	113½	—	*5 14 8
do. do. Deb.	,,	4½	4½	81½	—	5 4 4
Lond. & Sub. Trac. 5% Pref. ...	1	5	2½	6/6	—	7 13 10
London United Tram. Deb. ...	Stock	4	4	51½	—	7 15 4
Mexico Trams, 5% Bonds ...	—	Nil	5	71	—	7 0 10
Mexican Light Common ...	100	Nil	Nil	24	—	Nil
do. Pref.	100	Nil	Nil	60	+7½	Nil
do. 1st Bonds ...	—	5	5	67	+1	7 9 3
Yorkshire (West Riding) ...	1	—	5	1½	—	4 0 0
MANUFACTURING COMPANIES.						
Babcock & Wilcox	1	20	12	55/-	—9d.	*4 7 3
British Aluminium Ord.	1	5	5	32/-	—	3 2 6
British Elec. Transformer Pref.	1	Nil	Nil	17/6	—	... ...
British Insulated Ord.	1	15	15	3	—	5 0 0
Brush Ord.	1	10	10	24/6	—	8 3 4
Callenders	1	15	15	3	—	5 0 0
do. 6½% Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	5	Nil	1½	+ ½	... ...
Edison-Swan	4/-	7½	10	6/6	—	6 8 0
do. 5% Deb.	Stock	5	5	81½	—	6 0 3
Electric Construction	1	10	10	22/6	—2/-	6 3 1
Enfield Cable, Pref.	1	7½	7½	24/-	—	6 5 0
English Electric	1	8	5	20/3	—	4 18 9
do. do. Pref.	1	6	6	21/6	—	5 11 7
Gen. Elec. Pref.	1	6½	6½	23/3	—	5 11 10
do. Ord.	1	5	5	22/9	—6d.	4 8 0
Henley	1	15	15	3	—	5 0 0
do. 4½% Pref.	5	4½	4½	4¼	—	5 6 0
India-Rubber	1	10	5	17/6	—	*5 14 3
Johnson & Phillips	1	5	5	1⅞	—	3 16 2
Met-Vickers, Ord.	1	12½	8	1¼	—	6 8 0
do. Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	5	—	1⅞	— ⅛	4 4 0
Telegraph Construction	12	20	20	27	+ ½	*4 9 0

*Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.	Price Feb. 2.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	6¾d.	
a Ammoniac, Sal ... ... per ton	£60	
a Ammonia, Muriate (large crystal) ,,	£52	
a Bisulphide of Carbon ... ... ,,	...	
a Borax ... ... ,,	£25	
a Copper Sulphate ... ... ,,	£25 10s.	
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	
a ,, Perchlorate ... ... ,,	5½d.	
a Shellac ... ... per cwt.	£15 15s.	
a Sulphur, Sublimed Flowers ... ,,	£7 15s.	
a ,, Roll ... ... ,,	£7 15s.	
a Soda, Chlorate ... ... per lb.	3d.	
a ,, Crystals ... ... per ton	£5 to £5 5s.	
a Sodium Bichromate, casks ... per lb.	4d.	
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£120 to £125	
b ,, Wire ... ... per lb.	1/9 to 2/6*	
b ,, Sheet ... ... ,,	1/6 to 2/-	
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£241	£1 dec.
Grade II ... ... ,, ,,	£174	£1 dec.
Grade III ... ... ,, ,,	£101	£1 dec.
c Brass (rolled metal 2" to 12" basis) per lb.	10½d.	½d.
c ,, Tubes (solid drawn) ... ,,	1/0½ to 1/0½	
c ,, Wire, basis ... ... ,,	10½d.	½d. dec.
c Copper Tubes (solid drawn) ... ,,	1/1½	
c ,, Bars (best selected) ... per ton	£95	£2 dec.
c ,, Sheet ... ... ,,	£95	£2 dec.
c ,, Rod ... ... ,,	£95	£2 dec.
d ,, (Electrolytic) Bars ... ,,	£89 5s.	
d ,, ,, Sheets ... ,,	£143 10s.	
d ,, ,, Wire Rods ... ,,	£79 5s.	
d ,, ,, H.C. Wire per lb.	9½d.	½d. dec.
f Ebonite Rod ... ... ,,	2/- to 3/6	
f ,, Sheet ... ... ,,	2/- to 3/6	
g German Silver Wire ... ... ,,	2/3	
h Gutta-percha, fine ... ... ,,	6/6	
h India-rubber, Para fine ... ... ,,	1/5½	1½d. dec.
i Iron Pig (Cleveland Warrants) ... per ton.	£5 2s. to £5 2s. 6d.	
j ,, Wire, galv. No. 8, P.O. qual. ,,	£30	
g Lead, English Pig ... ... ,,	£28 5s.	2/- dec.
g Mercury ... ... per bot.	£13 10s. —£13 15s.	10/- dec.
e Mica (in original cases) small ... per lb.	3d. to 9/-	
e ,, ,, medium ,,	4/- to 8/-	
e ,, ,, large ... ,,	10/- to 20/- & up.	
p Phosphor Bronze, plain castings ,,	1/9½	
p ,, ,, drawn bars & rods ,,	1/9	
p ,, ,, rolled strip & sheet ,,	1/9½	
p ,, ,, wire ... ... ,,	1/4	¼d. dec.
o Platinum ... ... per oz.	£24	
J Silicium Bronze Wire ... ... per lb.	1/0½	
r Steel, Magnet, in bars ... ... ,,	7½d.	
a Tin, Block (English) ... ... per ton.	£261 to £261 10s.	5/- inc.
a ,, Wire, Nos. 1 to 16 ... ... per lb.	4/2	

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
j Richard Johnson & Nephew, Ltd.
k P. Ormiston & Sons.
o Johnson, Matsey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W F Dennis & Co

Canadian Water Power in 1924.—In his annual statement upon water-power development in Canada, the Minister of the Interior said that over 300,000 h.p. of plant had been added during 1924, at a cost of about $45,000,000, bringing the total installation up to 3,569,275 h.p. In addition to this, however, works were nearly completed to the extent of a further 600,000 h.p.; this plant would be put into commission during the current year. The greater part of the plant brought into service during the past year was in Quebec and Ontario. The former province contributed the most, 175,000 h.p., the principal developments being those of the St. Maurice Power Co. on the St. Maurice River; the Northern Canada Power Co. on the Quinze River; and the Montreal Light, Heat and Power Consolidated at the Cedars Rapids on the St. Lawrence. Several other important undertakings in Quebec will be completed during this year. Ontario added 132,000 h.p., most of the work being carried out by the Hydro-Electric Power Commission. Further sets were installed at the Queenston-Chippawa (Niagara) plant, and the Cameron Falls development on the Nipigon River, and smaller developments were carried through on the Trent, Muskoka, Beaver, and South Rivers. The Hollinger Consolidated Gold Mines, Ltd., also carried out work on the Abitibi River, as did the Backus-Brooks Co. at Kenora, and the Canadian Niagara Power Co. at the Niagara Falls. Development on a smaller scale proceeded in the other provinces. No new installation was made in British Columbia, but extensive works were under way by the B.C. Electric Railway Co. on Stave Lake, and the West Kootenay Light and Power Co. on the Kootenay River.

Alignment Charts for Tariffs.

By REGINALD O. KAPP, B.Sc., A.M.I.E.E.

TARIFFS for electric power are generally sufficiently complicated for it to be necessary to go into a fair amount of arithmetic in order to find out what a given consumer would have to pay. Such arithmetic is irksome, when a new tariff is being discussed and elaborated. In such a case one has to find out quickly how, say, for the usual type of two-part tariff a given increase in the kilowatt charge and a given decrease in the unit charge would affect the total cost per unit.

Calculations based on more or less complicated tariffs have to be made with great frequency by the official of an electricity supply undertaking who deals with the applications of prospective consumers. The consumer will tell him that it is proposed to take so many units per year; the peak load will be so many kilowatts; the power factor so much, and then the official must work out what the total cost per unit for this consumer will be. This is the type of calculation that can be carried out entirely on the slide rule, but it is also the type of calculation in which one is very liable to be caught in one of the snares in the path of the user of the slide rule, the most frequent being in this case to divide two figures that should be multiplied, or to take the reciprocal of a quantity, or to make a mistake in the position of the decimal point. Such calculations are, therefore, of the type that is much more safely and quickly dealt with by alignment charts.

An engineer can make such charts for himself without very great difficulty, and fig. 1 may serve as an illustration as it deals with the general case of a two-part tariff. The chart can be used equally well for a kilowatt charge as for the kVA charge for which it is drawn. If the consumer is to be charged for his maximum demand in kilowatts, the right-hand vertical scale can be taken as a measure of kilowatts, not kVA; the vertical lines on the grid would correspond to £s per kilowatt, and the centre vertical scale would be a scale of load factor only. This diagram covers all usual two-part tariffs likely to occur, and it can be used in the inverse way to show how, under given conditions, a certain total cost per unit can be split up into its two constituents.

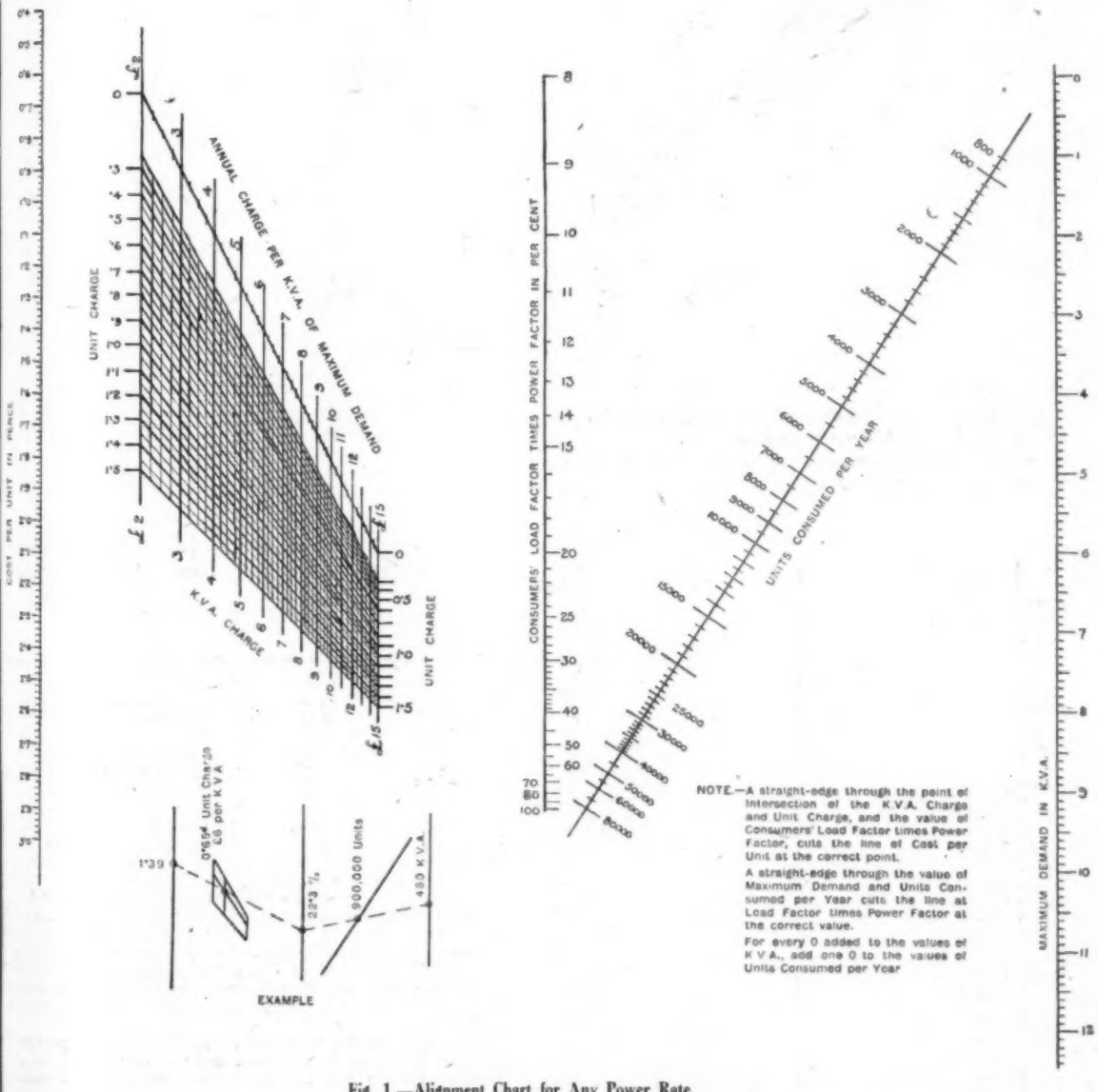

COST PER UNIT IN PENCE
UNIT CHARGE
ANNUAL CHARGE PER K.V.A. OF MAXIMUM DEMAND
K.V.A. CHARGE
UNIT CHARGE
CONSUMERS' LOAD FACTOR TIMES POWER FACTOR IN PER CENT
UNITS CONSUMED PER YEAR
MAXIMUM DEMAND IN K.V.A.
NOTE.—A straight-edge through the point of intersection of the K.V.A. Charge and Unit Charge, and the value of Consumers' Load Factor times Power Factor, cuts the line of Cost per Unit at the correct point.
A straight-edge through the value of Maximum Demand and Units Consumed per Year cuts the line at Load Factor times Power Factor at the correct value.
For every 0 added to the values of K.V.A., add one 0 to the values of Units Consumed per Year
EXAMPLE
1·39
0·65d Unit Charge
£5 per K.V.A.
22·3 %
900,000 Units
403 K.V.A.

Fig. 1.—Alignment Chart for Any Power Rate.

In devising a two-part tariff it is sometimes useful to separate consumers' load factor and consumers' power factor and for this case, the type of chart shown on fig. 3 may be handier. It has the advantage over fig. 1, for instance, of showing how much the consumer

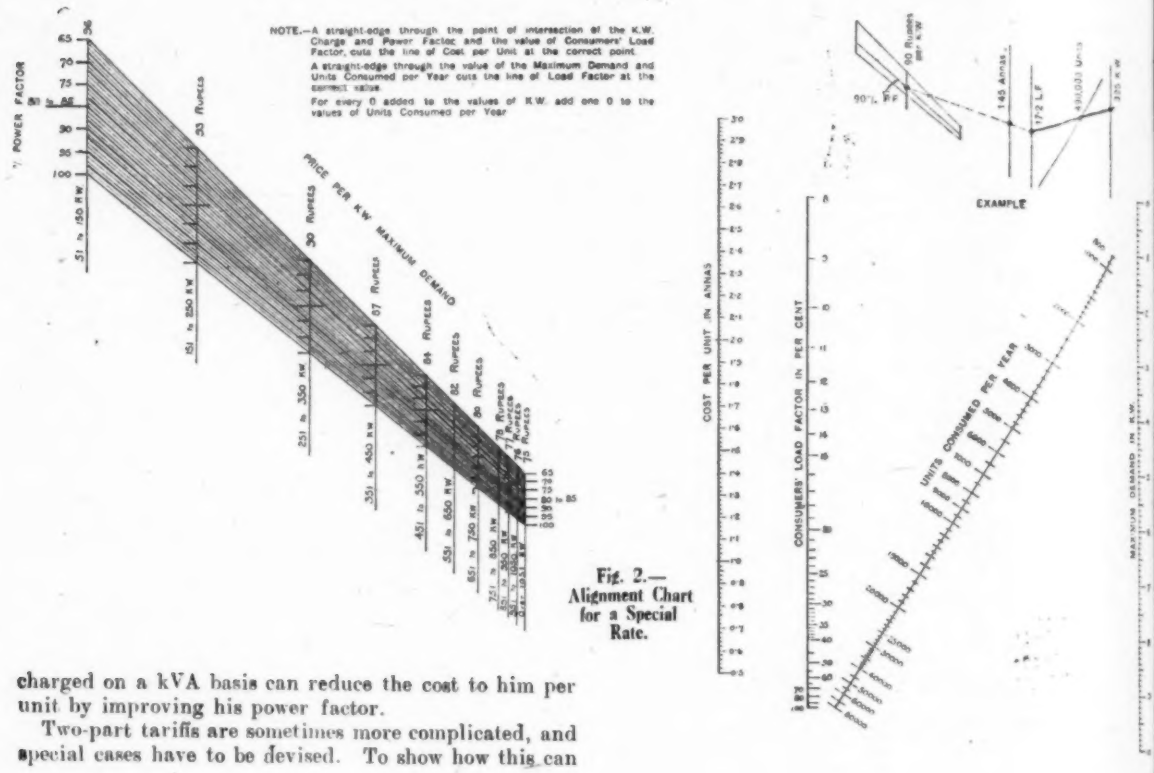

NOTE.—A straight-edge through the point of intersection of the K.W. Charge and Power Factor, and the value of Consumers' Load Factor, cuts the line of Cost per Unit at the correct point.
A straight-edge through the value of the Maximum Demand and Units Consumed per Year cuts the line of Load Factor at the correct value.
For every 0 added to the values of K.W. add one 0 to the values of Units Consumed per Year
% POWER FACTOR
PRICE PER K.W. MAXIMUM DEMAND
RUPEES
COST PER UNIT IN ANNAS
CONSUMERS' LOAD FACTOR IN PER CENT
UNITS CONSUMED PER YEAR
K.W. DEMAND
EXAMPLE
90% P.F.
145 Annas
17½ L.F.

Fig. 2.—Alignment Chart for a Special Rate.

charged on a kVA basis can reduce the cost to him per unit by improving his power factor.

Two-part tariffs are sometimes more complicated, and special cases have to be devised. To show how this can

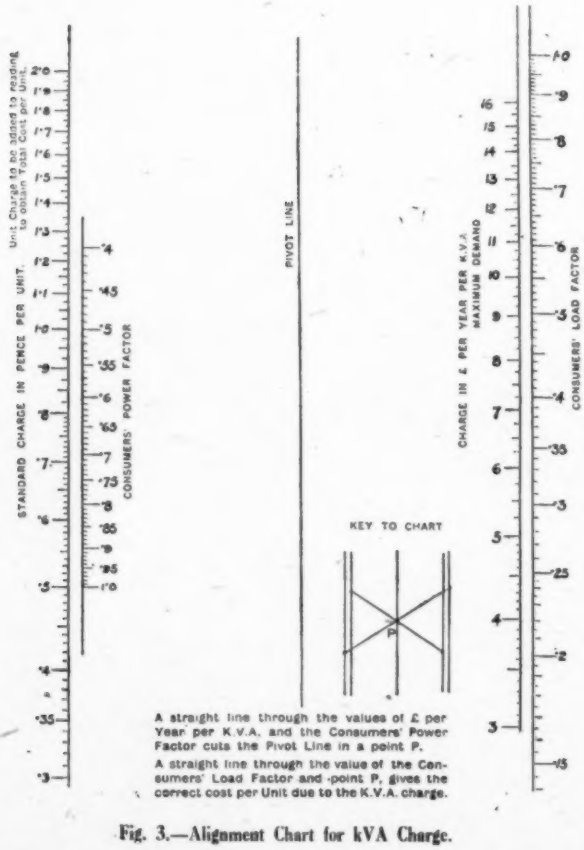

STANDARD CHARGE IN PENCE PER UNIT.
CONSUMERS' POWER FACTOR
PIVOT LINE
CHARGE IN £ PER YEAR PER K.V.A. MAXIMUM DEMAND
CONSUMERS' LOAD FACTOR
KEY TO CHART
A straight line through the values of £ per Year per K.V.A. and the Consumers' Power Factor cuts the Pivot Line in a point P.
A straight line through the value of the Consumers' Load Factor and point P, gives the correct cost per Unit due to the K.V.A. charge.

Fig. 3.—Alignment Chart for kVA Charge.

be done in a typical case that does not look very promising at first sight, fig. 2 has been constructed for the tariff adopted by a company in India, which imposes a two-part tariff with an unvarying unit charge and a sliding scale for the kilowatt charge. This company has a small bonus and penalty for power factor, the penalty being imposed if the power factor is below 80 per cent., and the bonus being earned if it is above 85 per cent. The bonus and penalty is 2½ annas per 1,000 units per 1 per cent. of power factor variation.

Mistakes in the Application of Electric Motors.—A paper was read by Mr. T. H. Windibank before the National Association of Supervising Electricians on December 9th, in which the author's object was to expose some of the more common faults made by contractors, wiremen, &c., in the installation of electric motors. The author says there is often a lack of system in quoting for a buyer's requirements, efficiency and load factors appear to be of no account, and the suitability of a particular type of machine, or the reliability and safety of its starting gear, is of small concern. The public is often victimised because of a stipulation that wires are to be run in conduits; the wires are, in accordance with this stipulation, run in conduits, but left unprotected at the most vital points, such as the entrances to switches, &c.

The author suggests that pipe-ventilated machines with their great advantages should be used in many cases where it seems that the protected type or the totally enclosed type are adopted out of ignorance of the existence of other types of motors, and that through anxiety to secure a job at any cost the buyer is often provided with a motor unsuitably installed.

The author states that the contractor is often responsible for bad ratios in belt drives, and suggests that the contractor is often not aware of the importance of accuracy in this regard.

A summary of the principal faults dealt with by the author is as follows:—

(1) Lack of system in quoting for electric motors.
(2) Lack of serviceable advice to the buyer either regarding the motor or the installation.
(3) Omission to select the most efficient machine.
(4) Omission to select the most suitable type of machine, including the all-important question of the type of bearing.
(5) Lack of care in selecting the correct horse-power.
(6) The prevalence of bad layouts and the omission to select carefully the correct individual or group drives.
(7) Lack of ingenuity in placing the motor.
(8) The omission of essential protection to life and property in the starting gear.
(9) Bad installation work, such as the omission of proper air intakes, pipe ventilation, unsuitable belt ratios, pulley sizes, &c.
(10) Bad wiring, showing a paucity of ideas.

Electrical Accidents in Mines.

(*Concluded from page* 191.)

Systematic Testing.

Investigation of the circumstances attending those accidents in which defective earthing was a contributory cause, shows that in the majority no effective or systematic tests were carried out to ascertain the actual value of the earthing system. Testing should be regarded as a preventive method, and as such should be used to anticipate defects by drawing attention to necessary improvements in design and in the standard of maintenance.

To lay off any considerable length of cable for such tests may entail considerable inconvenience, but each section of the cable system ought to be tested for conductivity, as well as for insulation, at least once in 12 months.

There is no difficulty, however, in measuring the resistance at the various points where the metallic covering of cables is cut for attachment to joint boxes and to other apparatus without interruption of service, and this should be done much more frequently.

The earthing contacts between plug and socket for coal-cutting machines should be tested for conductivity frequently and regularly. Actual measurement of the resistance of the several conductors in a trailing cable would probably disclose those partial fractures which result in short-circuits if undetected, and a more enlightened and generous allocation for routine testing would be repaid by fewer inconvenient interruptions during the coal-getting shifts. It may be necessary to amend the regulation touching this matter of tests by withdrawing the discretion allowed as to the frequency of the tests and by prescribing the manner in which they shall be made.

With regard to periodical examinations, as distinct from tests, it does not appear to be generally recognised that Section 66b of the Coal Mines Act, 1911, applies to the electrical machinery and appliances, and that General Regulation 131 (*c*) is supplementary to that section of the Act and not in lieu thereof. A trained and experienced electrician is the proper person to be appointed for the thorough weekly examination that is required by Section 66 (*b*).

Repairs of Trailing Cables.

Repairs of the dielectric and of the protective sheathing continue to be carried out in too many instances with such unsuitable material as "Empire cloth" and fibrous tapes. A cable that is insulated with vulcanised rubber can only be effectively repaired with the same medium.

At one large colliery in the Midlands, where there are some 50 coal-cutting machines in use, it is the practice to bring all trailing cables to bank at weekly intervals for thorough tests and any necessary repairs. This routine, coupled with effective inspection underground, ensures, as far as it is possible to do so, that accidents do not occur with trailing cables, and that the work of coalcutting is not interfered with through the development of unexpected defects in the cables and pummels.

Fires Underground of Electrical Origin.

Old Roundwood Colliery. July 2nd, 1923.

A piece of shale fell upon a trailing cable where it was coiled at the side of the gate road during the process of the cutting shift, and brought about a short circuit so that the cable insulation was destroyed over a length of 54 yards, and a brattice sheet was set on fire. The fire was observed by the machine men, who extinguished it. The cable was 3-core, 50/24 s.w.g. rubber-insulated cab-tire sheathed.

At the gate-end there was an oil-break circuit-breaker set to trip at 70 amps., which is believed to have operated. A subsequent test showed that 100 amps. was required to trip the switch in its condition at the time of the occurrence.

The system was 2-wire direct current at 500 volts, both conductors being insulated.

Between the main switchboard at bank and the gate-end box there was twin and single-core armoured cable of various sizes totalling a run of some 2,530 yards, having a total copper resistance calculated at 1.3 ohms.

The actual resistance, including joints and switch and fuse contacts, may have been twice this figure, thus limiting the value of the short-circuit current but permitting an arc to be maintained long enough to set fire to the rubber.

Houghton Main Colliery, Yorks. August 8th, 1923.

A heavy fall of roof occurred in a travelling road, between shifts, and so damaged an armoured cable that the conductors were short-circulited, and 3 feet of cable was destroyed and a 5-inch diameter prop and a 9-inch diameter bar were set on fire and continued to smoulder beneath the fall.

The cable was 3-core, 7/14 s.w.g. bitumen insulated and armoured with a single layer of steel wires.

The branch circuit was protected by fuses, 20 s.w.g. copper, and the main circuit was protected by an oil-break circuit-breaker set to trip at 200 amperes.

The fuses were not blown, but the circuit-breaker operated. The system was 3-phase at 650 volts, 50 cycles, the neutral point being normally insulated.

Rockingham Mine, Yorkshire. October 14th, 1923.

The insulation of a pair of unarmoured insulated conductors supplying a branch lighting circuit and passing through a hole in the wooden frame of a door becoming defective, a short-circuit occurred, as a result of which the timber was set on fire. The conductors were 7/20 s.w.g. insulated with vulcanised rubber.

The system was alternating current at 110 volts, obtained by a transformer from 3,300 volts, and the circuit was protected by small fuses which were blown.

Montgomeryfield Colliery, Ayr. October 22nd, 1923.

Some 20 yards of concentric cable, 19/18 s.w.g. rubber-insulated lead-sheathed and wire armoured, were destroyed as a result of a fire initiated by a short-circuit in the cable, and two men were overcome by the fumes. The pressure was 500 volts direct current, and a 300-kW turbo-generator was running at the time. There were no branch circuit fuses in the pit, but the circuit-breaker in the power house tripped when the current had risen from 50 to 400 amperes.

Other similar cables in the pit showed evidence of injury from passing tubs, and it is probable that the cable in question was injured in the same way, due to the inadequate width of the roadway.

One of the lessons to be learned from these occurrences is the impotency of the ordinary overload protective devices for the prevention of fire following electrical defects, and this indeed is a characteristic observed in connection with most of the occurrences of that nature, of which records are available. Sensitive leakage protection would, undoubtedly, reduce this hazard.

Besides the two cases of ignition of gas detailed under the heading of fatal accidents, there was one at Watnall Colliery, Notts., February 15th, 1923, in which, fortunately, no loss of life occurred:—

Four men were seriously burned while one received slight injury as a result of an ignition of gas in the vicinity of the machine-cut coal face.

The machine had been undressed preparatory to drawing out and flitting, and after drawing itself down the face for some 15 minutes, it was stopped to reset the haulage prop. Upon switching on to restart the machine, an accumulation of methane was ignited.

The machine did not purport to comply, in the matter of flame-proof enclosure, with present ideas, but the starting switch was oil-immersed, and this switch was not found to be defective.

It is to be presumed that the gas was ignited by arcing at the live contacts between plug and socket, one of which showed signs of burning due to bad contact.

In this conection it may be mentioned that a Committee of the British Engineering Standards Association has been at work for some time past upon the preparation of a specification for a flameproof plug and socket for mining use, and it is to be hoped that its labours will result in the production, in the near future, of a combination that will mark as great an advance upon the types in common use as has been achieved in other details of electrical equipment in the last few years.

General Remarks.

There is diversity of practice and a difference in the standards of excellence considered desirable or practicable in the various parts of the coal-fields and also between one pit and another in the same area, and

although the general rate of progress may not be rapid, advance is observable, notwithstanding the regrettable increase in the number of fatal accidents noted in this report.

Owners, managers, and electricians have in general shown their willingness to listen to suggestions, having as their object an increase of safety touching matters of detail which are only covered in general terms by the Regulations. Mr. Horsley makes acknowledgment in this report of the frank and helpful manner in which manufacturers of electrical apparatus for mining use have dealt with criticisms and suggestions addressed to them arising out of matters that have come to his notice during the course of his dutes while inspecting and as the representative of the Department on the various committees with which he has been associated.

Acknowledgment of similar assistance is also due to those consulting electrical engineers who are concerned with the application of electricity to mining, whose help has been sought in the endeavour to raise the standard of installation and of maintenance to a level commensurate with the advance in knowledge of the problems involved in so far as safety is affected.

Lest these remarks should seem to involve a general reflection upon existing practice, it may be necessary to add that at many collieries the standard already achieved is high, and generally a progressive spirit prevails, for experience has proved that first-class plant properly maintained and embodying modern systems of protection is sound engineering and good business.

We are also glad to note that the Inspector raises the question of certificates for electricians, and says:

"It is an anomaly that, although firemen, examiners, and deputies, as well as surveyors, under-managers and managers, must possess official certificates of competency, no such criterion has been established in the case of the electricians and assistant electricians."

Our readers are by now well aware of our views on this question, and we are glad to have this expression of opinion from such an authority.

Mr. Horsley further supports our views when he says: "An improvement in status and in authority commensurate with the responsibilities which are imposed by statute and by the exigencies of his work would naturally follow on the possession of an *official certificate* of competency by the *electrician*, and would be an *inducement to attract more men of superior education and ability* into that field of activity."

The italics are ours. Such a certificate, moreover, would give a measure of justice and encouragement to those already in the field. We have hopes.

A Report upon New Zealand.

MR. W. ELMSLIE, Trade Commissioner in the Dominion of New Zealand, has presented a report upon the Dominion* to the Department of Overseas Trade covering the year 1923, and 1924 up to August.

Mr. Elmslie says that in spite of a long drought in the spring of 1923 which affected crops and pasturage, the prices of produce brought a satisfactory return to pastoralists. Trade remained steady, and no unusual difficulties arose to interfere with the profitable conduct of the business of mercantile houses. Increasing energy and effort are being devoted to opening up and developing the country; the policy of the Government is to improve the means of access to primary producing districts, to add to the amenities of country life by bringing within the reach of settlers telephones and electric power for the operation of labour-saving devices, and to make more land available for closer settlement by drainage, irrigation, and other means. Railways are being extended and improved; road development is being pursued; work is being pushed forward on hydro-electric undertakings, which are so designed as eventually to link up and supply the whole Dominion on an organised system; and telephone services are being greatly extended.

External Trade.

The Customs returns for 1923 show that goods valued at £43,378,493 were imported, as compared with £35,012,561 in 1922. The rate was maintained during the first half of 1924, the total importations being valued at £22,644,403. Although stocks are large, the great prosperity of the country makes the consuming power equally great, and importation may continue on the present high scale unless a fall in the price of exported produce causes a check. Great Britain's share of the import trade rose in value, the figures being: 1922, £18,296,173; 1923, £22,532,205. At the same time imports from all other sources specifically mentioned also showed increases, an important one being the rise of the Canadian share from £1,556,213 to £2,950,984; imports of United States origin rose in value from £5,379,372 to £6,956,602. The last two increases are attributed to larger imports of motor vehicles, 80 per cent. of which came from the United States and Canada. The removal of the embargo upon the importation of German goods in September, 1923, reopened normal trade relations, but a strong prejudice against German goods remains, and the importation of these, while growing, is very small.

The export trade rose in value from £41,699,168 to £45,371,906, although, it is stated, the increase was due to higher price levels rather than actual expansion. The proportion sent to the United Kingdom fell from 86.3 per cent. to 81.2 per cent., while the United States took 7.7 per cent. as against 6.3 per cent. in 1922.

In the opinion of many competent observers the imports, especially of consumption goods and luxury articles, are going into New Zealand in larger volume than is desirable, and are adding to the difficulties of the primary producer, who is already handicapped by high production costs.

* Stationery Office. Price 2s. net.

Electrical and Allied Imports.

The imports are very thoroughly analysed in a lengthy appendix to the report, and from this the following information is obtained.

In "tubes, pipes and fittings" United Kingdom manufacturers had practically the whole trade in large sizes; in "cast tubes and fittings 9 in. in diameter and under" they supplied £56,228 out of £58,991; and in "wrought tubes 6 in. in diameter and under," out of imports valued at £382,951, the United Kingdom supplied £289,383, the balance coming mainly from Canada. The whole of the imported iron telegraph and telephone wire (£11,998) came from the United Kingdom. The proportion of bare copper wire supplied by the United Kingdom is falling, although the imports are increasing. The total value in 1923 was £227,132, Great Britain supplying £118,897, Australia £92,155, and Canada £13,311. On the other hand, the United Kingdom's share of the increasing imports of meters (gas, electricity, water, &c.) is growing, and in 1923 was 77 per cent. of the total (£134,548), as compared with 70 per cent. in 1922. In telephones and accessories, United Kingdom suppliers, with £56,567 out of a total of £139,103, secured a larger share of the trade than they have done for some years.

Although machinery in general showed an increase of from £2,769,325 to £3,007,509, electrical machinery was one of the classes in which there was a decrease. It is to be noted, however, that when electrical equipment is included, electrical imports as a whole greatly increased, being the largest ever recorded. About two-thirds of the trade is held by United Kingdom manufacturers, who supplied in 1923 goods to the value of £963,722 out of a total of £1,448,844. Details of the imports of electrical goods and apparatus in 1923, and a comparison with the 1922 statistics, were published in the ELECTRICAL REVIEW of December 5th, 1924 (p. 874). It is stated that Canada is becoming a serious competitor for the trade in insulating materials, unenumerated electrical materials, and electrical machinery.

In general engineering machinery, including gas, oil, and steam engines, boilers, water turbines, locomotives, &c., nearly 80 per cent. of the total imports, which were valued at over £330,000, were of United Kingdom origin.

Trade with the United Kingdom in optical, surgical, and scientific instruments is steadily decreasing; it has fallen from 51.5 per cent. in 1914 to 27 per cent. in 1923.

Hydro-Electric Development.

The extensions of hydro-electric systems are making good progress, but it seems probable that the demand for power will grow more rapidly than was anticipated, and that new work will have to be undertaken at an earlier date than originally planned.

It was expected that the supply from the Mangahao undertaking would be commenced within a few weeks of the completion of the report.*

The Lake Coleridge extension scheme is under construction, and part of the new plant has been ordered. The load has

* The undertaking was formally inaugurated on November 3rd last.

increased as expected, and it will probably be necessary to begin development of another site at an early date. The Government has, however, given no indication of its intentions in this direction.

As has already been mentioned in our columns, the contract for the development of 45,000 kW at the Arapuni site has been given to Sir W. G. Armstrong-Whitworth & Co., Ltd.; work has already been commenced, and the installation is to be completed within three years. Here, also, demand for power is growing fast, and it seems probable that extensions will have to be undertaken as soon as the first development is complete.

The New Plymouth Borough station and the Taranaki installation are now under construction, and several new projects are under investigation. The great activity in extension of power development is reflected in the increasing imports of all electrical plant and materials, which seem likely to become one of the most important groups in the trade returns during the next few years.

The Telephone Service.

As from October 1st, 1923, a new system of rating for private and business telephones was put into force which imposed higher charges in business areas and lower charges in suburban and rural districts with the object of stimulating development. In spite of the reduction in rates, the Department's accounts showed a profit of £568,370 for the year, only £4,400 less than that of the previous year; out of this profit a considerable expenditure is being incurred on extensions of the telephone service. During the year new manual exchanges were opened at 10 small centres, many extensions were made to automatic equipment, switchboards, and cable systems, and a new automatic exchange (2,000 individual lines and 100 party lines) was completed at Wanganui. New automatic exchanges are under construction at Auckland, Wellington, Christchurch, and Dunedin, and further new work is contemplated. The number of telephone stations in the Dominion has increased steadily from under 50,000 in 1914 to over 105,000 in 1924, and all indications point to an increasing rather than a diminishing demand for service.

General.

The Government has secured the services of two British railway experts to inquire into and report upon the organisation and running of passenger and goods traffic and matters relating to the mechanical operation of the State Railways. It is expected that they will be able to make recommendations of great value to the management of the railways. The Minister for Railways also has under consideration the question of the electrification of suburban lines, and it is expected that he will shortly make an announcement of his proposals for development in this direction.

Mr. Elmslie states that a great deal of business has been lost to British traders owing to their failure to study and understand the requirements of buyers, the habits of the country, or the channels through which business can best be obtained. Visits should be paid by senior members of firms, if possible; if this cannot be done more reliance should be placed upon the reports of local agents. A principal who does not give very careful consideration to the recommendations of his local agent is sacrificing half the benefit that can be derived from representation in the market.

Failure to give "service" is one of the most frequent causes of loss of business in all classes of trade in machinery, plant, and instruments. Mr. Elmslie illustrates this by quoting the example of an order for an X-ray outfit costing £1,400. Preference was given to American plant, although it was considerably dearer, because of the inability to obtain satisfactory "service" from English makers or their agents.

Mention is made of the growing practice of manufacturers selling goods to small retailers upon wholesale terms, a practice which reacts unfavourably upon attempts to be represented by reputable wholesale firms. It is suggested that inquiry as to the actual destination of the goods with more favourable terms to wholesale houses is worth consideration by British manufacturers.

The Design of Electrical Control Gear and Connections.

Protection Against Shock, Fire, and Faults.

By H. W. CLOTHIER, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Concluded from page* 200.)

In reviewing known automatic protective systems, stress is laid upon the importance of the "stability ratio." Stability takes precedence over sensitivity; in balanced automatic protective systems stability is jeopardised by influences, some of which are of recent discovery and have been brought to light by new conditions of service. They include the unbalancing effect of high-frequency oscillations on main lines, and interference by induction between the main line and the pilot line. Suitable remedies are available and have been applied. The criterion of quality of any protective system is its stability ratio, *i.e.*, the ratio between the maximum "straight through" current and the minimum fault-current setting that can be procured without any risk of inadvertent tripping after taking all the disturbing influences into consideration. The growth of the fault current on the occurrence of a short-circuit is extremely rapid, and it is not possible to prevent it from reaching its maximum current value by making the protection sensitive. Even if it were practicable for the relay to have no electrical and mechanical inertia, there is still the comparatively long interval, say, three or four periods, during which the circuit-breaker is accomplishing its train of movements. It is therefore wrong to rely upon sensitiveness to limit the maximum current stress on the system.

What matters most is the acceleration of all moving parts right up to the separation of the contacts of the circuit-breaker, the aim being to reduce to a minimum the period during which the fault is allowed to damage the system. It is not safe to depend upon limiting the amount of fault current by inserting resistance between the neutral point and earth. This can only help on the occurrence of a fault to earth, and no amount of scheming with protective gear will prevent the possibility of simultaneous earth faults occurring on different phases, maybe on different parts of the system. Every aspect, including relay settings, must therefore be subordinate to the maximum current possible on short-circuit between phases. In this light the value of the resistance connecting the neutral to earth is a matter for discussion. Certainly the stability of protective gear should not be sacrificed for the sake of ultra-sensitive relay settings, the need for which is solely due to the desire to cut down the amount of the earthing resistance. Rather save the entire cost of the earthing resistance and secure solidity by connecting the neutral directly to earth. For feeder protection this would permit the use of robust relays set like those for overload protection at 2-3 times full-load current. For generator protection, in addition, the relation between the fault setting and the neutral earthing resistance also determines what proportion of the alternator winding is covered by the protection against single earth faults. The resistance may reduce, to a value below that at which the relay will function, the current flowing into the fault in those parts of the winding nearest to the neutral point. If this were to happen, the fault would continue without disturbance until it developed into something more serious, or until it was observed and the machine shut down by hand. As an example, in a station with generators of 10 per cent. internal reactance, given robust relays set to trip at a fault current of 50 per cent. of the full-load current, an earthing resistance which will allow twice the full-load current of the largest single generator to flow, and a stability ratio of not less than 40:1, there will be no inadverent tripping on any possible amount of "straight through" current. The whole of the stator winding will be covered for faults between phases, and 75 per cent. of it for single earth faults. If more than this is required, either the relays must be made more sensitive, or the ohmic resistance must be reduced; the former may be the more economical if the resistance must be retained, but the latter is better when considering comprehensively the protection of the whole supply system; and if carried out to the full by the elimination of the resistance altogether, it would also be the most economical.

The current entering into a section is not the same in phase and amplitude as that going out in the case of oscillations in a cable carrying "straight through" current when the cable, acting as a condenser distributed throughout its length, is in series with heavy arcing. Discharging over its whole length towards one end, the cable passes more current at that end and sets up in the pilot-wire circuit an induced high-frequency transient which has proved to be sufficient to cause inadvertent tripping on long lines used for 33,000 and 66,000-volt transmission. The influence on the pilot cable of direct induction between the cables themselves is unusual,

but it has been encountered upon the same 66,000-volt system, so much so as to be the suspected cause of breakdown of the insulation of the pilot cable on a single-cable three-phase system. Fortunately there are remedies for all of the unbalancing influences so far encountered.

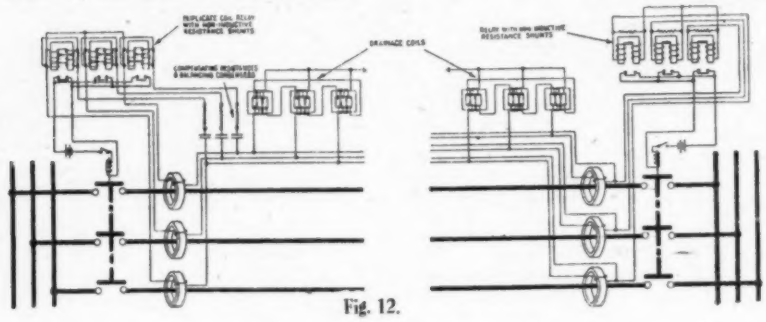


Fig. 12.

Merz-Price protection is simple, and suitable for use with instantaneous relays of a robust character. It may be used on ordinary feeder lines two miles long where the "straight through" current on short-circuit might be 10,000 amperes. The relay settings would be about 400 amperes for "between phase" faults and earth faults. Thus the stability ratio is 25:1. To compensate for the unbalancing influence of the capacity current, condensers (Whitcher) have been experimentally applied, but in practice in this country the compensated pilot found greater favour (Beard-Hunter). As an alternative when a further stabilising element is necessary, and when compensated pilot cables may not be used on account of additional expense, an arrangement with two relays in series has points of interest (Beard-Porter). One relay has a slight lag by added inertia, but a sensitive setting; the other has a comparatively heavy setting, but instantaneous action. The principle is carried a step further by the diverter relay system (Biles). The instantaneous relay does not trip the circuit-breaker directly, but only makes the inertia relay more stable by adding resistance in circuit with the coil whilst the heavy "through" transient is passing. As compared with the preceding example, with a corresponding length of line the earth-fault setting may be reduced from 400 to 100, and the stability ratio increased from 25:1 to 100:1, notwithstanding the influence of the pilot capacity-current. Tuned relays for the elimination of the unbalancing influence of oscillatory currents which can operate only with a flow of power current of or about the normal frequency of the system (Leeson) employ

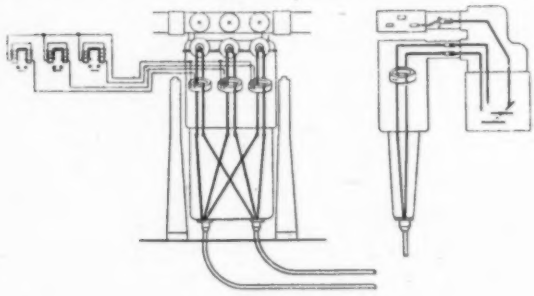


Fig. 13.

contacts mounted on reeds mechanically tuned to correspond to the natural frequency and have shown promising results in experimental stages.

The remedy for the vagabond induced voltage on the pilot wire is similar to that which has been applied to telephone circuits. Differentially-wound induction coils connected to each phase of the pilot wire form a non-inductive path to earth for the induced current, but a highly inductive path for the normal currents which circulate in the pilot wire at the instant of a fault; "drainage coils" do not materially interfere with the fault tripping-values of the relays. The risks can be reduced to a minimum by good bonding at the joints in order to avoid the earth-return fault current taking a vagabond path. An aggregation of the foregoing on a 3-core pilot system is shown in fig. 12; one side of the diagram shows the use of compensating condensers, and the other the compensation by pilot-wire sheath. Fortunately, the use of all the accessories is necessary only on very rare occasions.

Relays with a definite time-limit action by pendulum or clock mechanism are restricted in scope, but split-conductor protection is exceptionally useful as involving practically no expense when two existing cables (Glasgow and Sheffield Corporations) can be used in parallel on one split-conductor switch. In fact, sometimes the entire cost of two switchgear panels can be saved (fig. 13) and its combination with Merz-Price gear (the Hunter 4-core system) is said to be the most economical in new cables from a cable-making standpoint.

The stability of Merz-Price generator and transformer protection is rendered more secure by adding to the plain relay, pilot, and transformer system some stabilising feature such as the "bias" (Wedmore and McColl) or the "diverter" relay. With the latter the fault-setting may be reduced to 10 per cent., the stability ratio increased to 200:1 and, with the resistance to pass twice full load, 95 per cent. of the winding will be protected, or, with the resistance reduced to full load, 90 per cent.

The best remedy for a failing generator field is a reliable air-break switch that will not inadvertently trip. Its rare occurrence may be safely left to manual operation, and closing the ventilating shaft and steam stop-valves is all to the good, but the automatic cutting-out of a fault should be effected so rapidly that a serious fire cannot start inside the machine. Generator auxiliaries are an important factor in maintaining continuity of supply, and in large power stations the power behind the switch is considerable, so that the ordinary service fuse equipment and l.p. switchboards are generally inadequate. There should be nothing in the nature of low-voltage releases, or anything that may be accidentally tripped in cleaning operations. Fuse protection, provided the fuses are heavy enough to prevent premature blowing on occasinal overloads, is permissible, but complete enclosure is essential; l.p. metal-clad, oil-immersed fuses have been made for this purpose. The other part of the problem concerns the layout of an alternative supply.

The phase-angle errors and unbalancing influences to which any two transformers in the same protective circuit are prone are eliminated by the use of a single iron core as in the (Beard) system of "self-balancing." This core can be designed to slip over the lead of the main alternator cables and, in co-ordination with the design of the alternator frame, affords a good solution of the terminal question, the terminals being given the prominence they deserve by being brought to the surface (fig. 14). At the side of the protective transformer and terminal box is the usual emergency pillar containing the main field circuit breaker, and a press-button release for the main oil circuit-breaker and the field switch. The diagrammatic scheme of connections, including protection, field control, and interlock, is shown in fig. 15.

The protection covers the stator windings, terminals, and the main cables to the switchgear. The relay contacts open first the main stator circuit, and then the field and neutral earthing circuits. The field may be closed by hand, but cannot be opened by hand whilst the stator is closed; the stator cannot be closed on an open field. Relay-tripping by

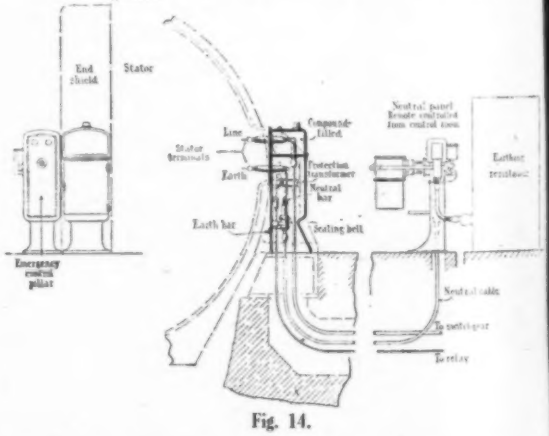


Fig. 14.

hand for trial of mechanism from the control room opens the stator, but not the field circuit; the emergency release on the engine-room pillar opens the main circuit and field circuit in sequence. The complete metal enclosure of all circuits, including the neutral, will be noted.

The relation of interference with telephone service and fault occurrences on power supply systems provides a further argument in favour of good bonding, earthing the neutral, and the instantaneous isolation of faults. Due to the risk of shocks and fires from telephone and telegraph leads, occasioned by induced voltage, in some places it has been necessary to insulate telephone wires between sub-stations as for h.p. service (3,000 volts), and to resort to the use of "drainage coils.' If the system can be arranged for the fault current to go and return along parallel paths in close proximity, the field of the outgoing conductor is neutralised by that of the return, and no currents would be induced in neighbouring cables. This requisite can best be obtained by completely enclosing all conductors in metal.

To conclude, the variety of designs and possible causes of trouble on protective gear may create an impression of reluctance to depart from the simple overload devices, but the the latter are the greater offenders in inadvertent operation. The simplest forms of balanced protection give efficient operation, and enormous benefit has been derived from them. The requisites for safety and continuity are briefly as follows:

(1) Universal metal-clad enclosure for:—(*a*) The confinement of dangerous conductors; (*b*) the preservation of insulation in compound and oil; (*c*) the restraint of fire and arcs within

a unit, and the impregnability of adjacent units; and (*d*) the reduction of cleaning functions and other interference with conductors and insulators.

(2) A stable neutral point at earth potential, giving:—(*a*) Durability of earthing and bonding; (*b*) stability on transient short-circuit "straight through" currents in sound sections, and instantaneous isolation of the faulty sections.

(3) Reliability in all operating mechanism, enhanced by

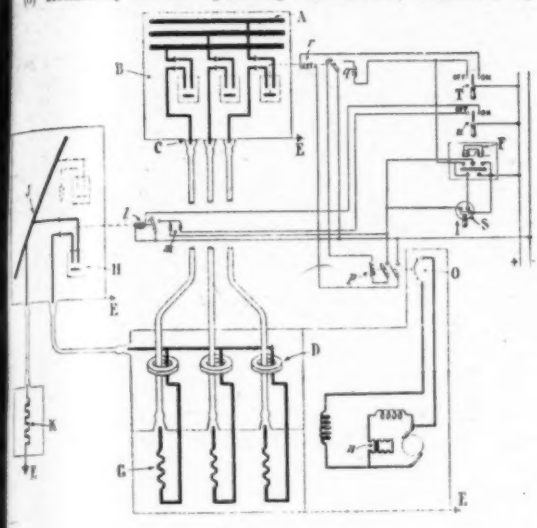


Fig. 15.

a. Main busbars.
b. Main oil circuit breakers.
c. Alternator cable gland insulated from earthed switchgear frame.
d. Self-balance current transformers (secondaries connected to winding of relay r) for self-balance protection against cable fault.
r. Relay. Armature operated upwards by self-balance protection and downwards by hand release for routine testing. The latter does not trip the field switch.
c. Alternator stator winding.
n. Solenoid control oil-break circuit breaker for neutral.
f. Neutral busbar common to all generators.
e. Earthing resistance.
l. Closing solenoid.
m. Trip-coils for hand and automatic control respectively.
s. Exciter shunt-field regulator.
o. Alternator field circuit breaker.
p. Trip-coil operated from relay r and emergency switch s.
q. Main circuit breaker trip-coil.
r. Contactor coil controlling the closing of the main oil circuit breaker.
s. Emergency control contactor located near alternator for opening main oil circuit breaker, followed at once by the main field circuit breaker and neutral earthing circuit breaker.
t. Remote-control switch for main oil circuit breaker.
u. Remote-control switch for neutral earthing circuit breaker.

periodical inspection and trial by hand-release of essential tripping movements.

(4) (*a*) Elimination of human error by security of interlocking, coupled with the indication of essential circuit connections; (*b*) strong flameproof enclosure for circuit-breaking elements; and (*c*) the reduction of destructive forces, if possible, but in any case the limitation of their duration to a minimum by all available measures.

CORRECTION.—We regret that in last week's report of the discussion on this paper, Mr. Christianson was given the wrong initial letters. It was Mr. T. C. Christianson who spoke.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Portable Paraffin Street Furnace.

This furnace, made by MESSRS. CONDRUP, LTD., 78, Fore Street, E.C.2, is designed for use with the horizontal type of blow lamp. The flame enters the side of the furnace instead of the bottom, as in the usual type of furnace. The blow lamp is detachable, and is suitable for separate use. The makers state that its weight, complete with lamp, is 26 lb.

A Smoke Warning Indicator.

In these days when smoke abatement is receiving a great deal of attention in its bearings upon public health and thermal efficiency, a device recently brought to our notice by MESSRS. KELVIN, BOTTOMLEY & BAIRD, LTD., 18, Cambridge Street, Glasgow, should be of particular interest to those in charge of boiler houses.

This device gives a constantly visual warning when smoke and heavy fumes are being emitted from a chimney stack. It consists, as will be observed from fig. 1, of a glass-fronted case in which there are one or more nozzles through which "samples" of the uptake gases are passed, and corresponding exits for these gases. At right angles to these and cutting through the path of the gases, a beam passes from a lamp and lens mounted at one side of the case. A small portion of the gases is drawn through the indicator and passed back to the stack by means of the upper exits, the necessary suction being usually obtained by piping the indicator to appropriate points of the flue gas path. The points of con-

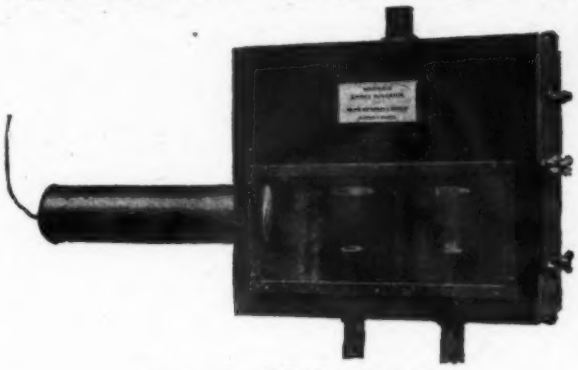


Fig. 1.—The "K.B.B." Smoke Indicator.

nection are chosen so that a suction of about ¾ in. of water acts on the indicator circuit. When the products of combustion are "clean" the beam is invisible, but smoke particles are immediately rendered visible. A door is fitted at the end of the indicator to allow of occasional wiping of the lens. The instrument can be mounted with the other boiler control apparatus.

An Adjustable Plug Adapter.

MESSRS. A. P. LUNDBERG & SON, 477-489, Liverpool Road, Holloway, N.7, have applied for a patent upon a new adjustable plug adapter. This device, which is illustrated in fig. 2, consists of a bayonet lampholder fitted with a two-pin plug. The threaded stems of the contact pins pass through grooves in U-shaped brass plates and are secured by locking nuts. As these grooves are in alignment with the diameter of the

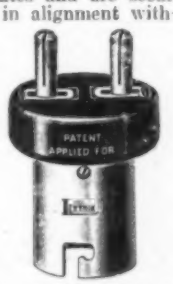


Fig. 2.—An Adjustable Plug Adapter.

body a method of adjustment is provided which enables the adapter to be used with standard or non-standard sockets, simply by the provision of pins of the correct diameter set at the proper distance apart. The firm has also made a gauge plate to facilitate the assembly of the adapters.

New "Tok" Switches and Plugs.

Among the more recent productions of TOK SWITCHES, LTD., Granville House, Arundel Street, W.C.2, are the rotary snap switch shown in fig. 3, and the interlocking switch-plug which is illustrated in fig. 4.

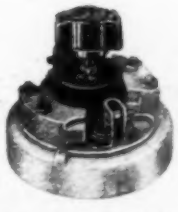


Fig. 3.—The "Tok" Barrier-type Rotary Switch.

Fig. 4.—The "Tok" Interlocking Switch Plug.

The principal new feature of the first is the provision of porcelain "choking" barriers between each pair of contact pillars; this is effective in reducing to a minimum erosion

of the contact blades by arcing. The moving mechanism carrying the contact blades is protected by an insulating ring as an additional safeguard. The company makes a special cover for this switch of non-hygroscopic, fireproof insulating material.

The second development—the switch-plug—has been developed to comply with the I.E.E. and Home Office regulations. This is known as the "Aristocrat Junior," and is an improvement upon the larger "Aristocrat" switch-plug. It is a combination of an indicating rotary snap switch (in which the speed of "make" and "break" is beyond the control of the operator) and a superimposed three-pin plug by which control of the rotary switch is effected. It is impossible to remove the plug while the switch is "on," or to operate the switch when the plug is out of the socket and the polarity cannot be reversed. On the underside of the plug a deep ring is moulded; this fits into a groove in the socket when the plug is in position. This ring prevents any accidental or deliberate contact with the "live" parts of the plug. Facilities for wiring have been incorporated in the design. The plug cap is held in position by two screws, which, when driven home, cause it to clamp down firmly on the leads, which are run on ledges on the bottom half of the plug, thus providing an efficient cord grip. Fig. 4 illustrates the flush type.

The "Quickway" Coil-Winding Machine.

In our issue of August 25th, 1922 (p. 263) we published a description of the "Quickway" winding and forming machine for making armature and stator coils. Since that date, owing to the demand, a machine of better mechanical design, embodying the same principles of winding and forming coils has been developed by the makers, the MIDLAND DYNAMO AND MOTOR REPAIRS CO., LTD., Belgrave Gate, Leicester.

Many firms having standard coil designs asked for a machine to wind special coils to suit their own particular needs. By an attachment or by modifying the design of the coil supporting members, the firm has succeeded in producing a variety of special coils which can be made at very low cost. For standard diamond-shaped coils with square, round or rectangular covered conductors, the Quickway method has proved to be very efficient where wire heavier than 22 s.w.g. is used. Even with fine wires where a perfect shape is essential, the machine can produce a satisfactory coil, with every wire in proper layer and place. The machine is readily adjustable to any size for every type of coil it makes. Coils wound with covered or bare strip bent on edge are made with little effort, and double evolute coils can be successfully produced by the use of special end guides.

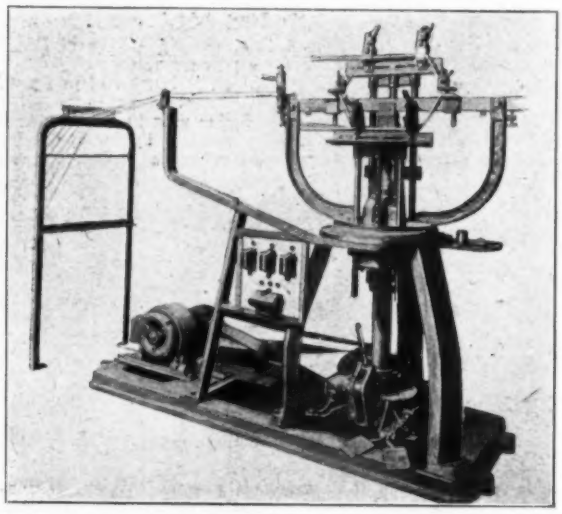


Fig. 5.—The "Quickway" Coil-winding Machine.

We reproduce a photograph (fig. 5) of one of the new machines similar to many supplied to the Admiralty. The General Electric Co. of America has recently asked the company to quote for another machine similar to the one already supplied to it.

An Unwanted Load.—The *Electrical World* reports that the Hydro-Electric Power Commission of Ontario has abandoned the sale of electric heaters, and is taking steps to reduce to a minimum the heating of houses by electricity. The Hydro shops have ceased stocking electric heaters and electric grates. The claim is advanced that these heaters put a purely seasonal demand on the system, making the consumption top-heavy in winter. Simultaneously with the dropping of heaters, the Commission is putting what consumers assert to be a prohibitive rate on house heating by electricity. This rate is said to have been ordered by Sir Adam Beck nearly a year ago, but is only now going into force.

Russian Notes.

Purchase of Copper Abroad.—The Elektrobank has received a licence to import 20,000 poods (322 tons) of electrolytic copper from abroad. The import of copper is due to the necessity of satisfying the requirements of the electrical industries with which the Soviet copper and cable works have not been able to keep pace.—*Reuter's Trade Service* (Moscow).

The Projected Dnieper Hydro-Electric Works.—The State Planning Commission has had under consideration a report on this scheme, it being suggested that the works should be established near the town of Alexandrovska. According to this report, the principal difficulty lies in the necessity for the satisfactory solution of a number of economic questions which are connected with utilisation of the rapids of the Dnieper. The general expenditure on the construction and equipment of the hydro-electric works is estimated at 170,000,000 chervonetz roubles, while the reorganisation of the industries in the region would increase the outlay to 270,000,000 roubles. After discussion the Commission reached the conclusion that it was necessary to secure more details as to the possible future demand for energy from the station. The complete scheme is to be drawn up by next March, and it is hoped to commence the work next October, and to complete it in five years.

Budget Grants.—In the Budget for the present quarter 11,700,000 roubles has been allotted to the continuation of works in course at various stations.

The Schatur Peat Fuel Station.—The Schatur station will occupy a pre-eminent position among the supply works operating on peat fuel in the province of Moscow. Two of the 16,000-kW generators are expected to be set in operation next March, while a third machine of the same output is proposed to be ordered shortly. Some of the electrical equipment is stated to have been received from England. The 110-000-volt line to Moscow has been completed to the extent of 75 per cent of the work, and the remainder will be finished by the beginning of April. It is stated that the station will take over 60 per cent. of the load in Moscow, and will also supply the needs of the local tramways.

New Stations.—The Novgorod Provincial National Economic Authority has begun the construction of the first hydro-electric works in this province, the power of the river Berezaike being utilised for the purpose. The object is to serve the needs of the rural population and the local co-operative societies. The Planning Commission of the province is completing preliminary schemes for the construction of six similar stations in the districts of Borovich and Valdai. At present there are 81 small stations in this province, with a total capacity of 7,000 kW. In the province of Penza a co-operative partnership has been formed with a capital of 200,000 roubles for the erection of a hydro-electric works on the river Sure of a capacity of 2,000 kW.

The Electrical Bank.—The first ordinary meeting of the Electrical Bank took place in Moscow on January 8th, when M. A. E. Holtman, one of the directors, presented a report stating that the share capital of 7,000,000 roubles was almost fully paid up, and the question of increasing the capital was being considered. However, the funds of the bank were far from being sufficient for the financing of the electrification of the Republics, and it would be necessary for the bank to participate in the allotment of funds included in the budget for works of electrification. Moreover, the bank ought to play a part in transactions relating to the granting of credit in the matter of import operations. In the case of the rural stations difficulties were experienced in financing these works, as the lighting loads alone proved to be unremunerative, and it was therefore essential to connect these stations with rural and domestic industries. The general turnover of the bank (apparently also of its predecessor) amounted to 7,000,000 roubles in the course of 10 months, and the profits were equal to 2.65 per cent. of the turnover. Concerning the present year a further report was submitted showing an estimated turnover in the nine months ending with next September amounting to 103,000,000 roubles, an excess of 1,611,000 roubles in income over expenditure and profits of 1.5 per cent. on the turnover.

Carbon Filament Lamps.—After extensive laboratory experiments, the Central Electrical Trust has embarked on the production of carbon filaments, carbon filament lamps still having a large sale in Soviet Russia. The trust has also started the manufacture of signal lamps for telephone exchanges, which have also never previously been made in Russia, the imports in recent years having amounted to about 100,000 per annum. Similarly, the production of wolfram filaments has been commenced, and it is hoped in all these cases gradually to reduce and finally abolish the imports of these lamps and materials. In connection with this matter, it is stated that the General Electrical Commission has under consideration the question of the constitution of a company for the production of wolfram for the purpose of meeting the requirements of the two factories of the Central Electrical Trust, and the lamp factory of the Leningrad Electrical Machine Trust, both of which, it is suggested, should become shareholders in the new company. Work is also being carried out by the Central Electrical Trust in connection with the production of metal filament lamps of a new type.

High-Voltage Insulators.—The arrival at Leningrad of 1,250 cases of high-pressure insulators from Hamburg for the Schatur system is reported.

Heavy Power Transmission Lines.

A Brief Survey: Future Possibilities.

Under the above heading Mr. J. H. Colyer recently read a paper before the London branch of the Association of Mining Electrical Engineers, wherein he dealt with the "organisation" of heavy transmission lines, describing in some detail a completed section of line (55-ft. steel angle-section towers with strings of three Twiss disk insulators) that forms part of what will be an extensive ring main. The author explained methods of erection, surveying, transport, office and field organisation, &c. He believes that trunk lines will undoubtedly play a great part in the future of industry in this country, and looks forward to what he describes as a "national bus-bar." In the course of the paper he points out, *inter alia*, that although the 1919 and 1923 Electricity (Supply) Acts gave compulsory power for obtaining the necessary way-leaves, their cost is even now in some circumstances considerably in excess of the value of the agricultural land put out of cultivation and the inconvenience caused thereby; and cases are not unknown where projected schemes have not matured, due perhaps to the conservative policy adopted by a land owner, over whose property the erection of a transmission line was contemplated.

Having regard to the possible future high voltages of overhead transmission lines in this country, the use of wooden poles and short spans will probably require to be restricted to those lines operating at voltages not exceeding, say, 33 kV. There is, even at the present day, too little use of steel structures, owing to prejudice against this type of construction, which has a wide use abroad, with greater economical results. If we wish to develop and keep pace with present and future demands, a more liberal view of high-power transmission surely must be adopted, and designers must be given a freer hand.

A line of moderate length capable of giving good service does not present insuperable difficulties, but the point of primary importance is whether such a line is the best possible construction for the particular duty required of it, *i.e.*, one which is not only substantially and lastingly constructed, but one also in which economic considerations have not been overlooked. On a route over uneven and mountainous country a standard type of support is often decided upon without considering the advantages that can be taken of steel lattice towers. Before the type of structure to be used is decided upon, a careful survey of the route should be made and the profile and plans prepared. In many cases main trunk lines will have to be carried over difficult mountainous country, where the cost of transport will in certain cases reach a very high figure. Therefore, it is of primary importance to reduce the number of supports by taking advantage of the natural features of the country. Another point in favour of long-spans is that as every insulator is a source of potential trouble, it may be necessary to consider the use, in certain cases, of steel-cored aluminium to enable longer spans to be used. When comparing the cost of materials a certain type of support may call for a lower first cost, but when transport and erection charges are added it may be found that the total cost will be considerably higher than if the more easily transported type had been decided upon. With towers galvanised down to the earth wire, the lower half being painted, there is no interruption of supply when painting is necessary; and if due care is exercised a galvanised tower should give at least 15 years' service for the comparatively small extra capital outlay involved. One of the primary causes of high erection cost is the fact that material is delivered inconsistently with the work which is being carried out.

When large steel structures for heavy transmission lines are erected in one piece, *i.e.*, the tower is lifted bodily and then placed in position, grave risks are involved, more especially when the towers have to be concreted, for the following reasons: After the tower has been erected and trued up, the concrete is filled in round the base, the towers are guyed and allowed to remain in this state till the concrete is set. Invariably the guys are not of sufficient stiffness to prevent undue vibration of the towers, and in nine cases out of ten the following day they are out of alignment, the work having to be done over again. Setting the base before erecting the super-structure is ecomoncally the best proposition, and the author has not known it to be necessary to go over, re-level, and true up any steel tower line after the super-structure had been erected.

The high cost of building heavy tower lines could be considerably reduced if it was made a standard practice to hinge all towers at the ground line, a method which considerably facilitates erection.

London Branch Discussion.

Mr. J. W. Gibson (hon. branch president) was in the chair, and Capt. A. C. Sparks (Messrs. Sparks & Partners) opened the discussion. Wayleave negotiations with some local authorities, in addition to landowners, had not proved easy, but he hoped that with the more general use of overhead lines, and the fact that lines had to comply with regulations laid down by the Electricity Commission such difficulties would be minimised in future. With regard to procedure, he was of opinion that they should first select the best route, then prepare the necessary preliminary survey, and then approach the parties concerned with wayleaves before proceeding further, *i.e.*, obtain the necessary sanction before making any definite progress with the line. It was probable that the majority of main-line transmission would be done with three sizes of conductor, around 0.1 sq. in. per phase, and that each pole would carry either three or six such conductors. With the regulations of the Electricity Commissioners as the basis, it appeared that contractors should now standardise within reasonable limits, more or less, sections being used to suit varying heights of pole; apart from other advantages, that would help the erection staff. With regard to the description of towers in the paper, as the base of the angle tower was 15 ft. 6 in., and of the terminal tower only 12 ft. 6 in., he assumed the former was more a special tower. Was a square base for this type of terminal tower as economical as a rectangular one? Concrete foundations had advantages. In some cases suitable stone was available from the excavation, and it was necessary to cart merely the cement and sand. To avoid the use of an undue amount of concrete, the centre of the foundation could be cored and filled in with earth when the concrete had set, if desired. Only in cases where they could not be avoided should bolted towers be used, unless they were so liberally designed as to allow for the lower factor of safety which he believed would generally be obtained with this type of pole as against the riveted type. In practice the strength of towers was more dependent on the human element when they were bolted than when riveted. Towers should be painted before assembly, in order to ensure that the joints of the various members and sections were adequately protected. Regarding bird insulation and guards to prevent unauthorised persons climbing the poles, he said it was important to avoid the junction of dissimilar metals as far as possible, or to protect such junctions, owing to the presence of moisture.

Mr. W. F. Bishop was not altogether convinced that the steel tower was the type which would be employed in this country. There had been a considerable number of lines put up with wooden poles.

Mr. T. Stretton was also very doubtful whether future transmission lines would be carried on the type of tower dealt with in the paper; to a very great extent he believed either wooden, or possibly reinforced concrete, poles would be used. Regarding large catchment areas in Scotland, he supposed that one of the largest was on Rannoch Moor. That was entirely bog land, and the type of pole described in the paper would be absolutely unsuitable for that area. The liquid found in boggy countries, whatever it was, seemed to have a most wonderful preserving effect on certain kinds of timber. He understood that the West Highland Railway was supported on brushwood. He had an idea of what the effect of the water would be on steel towers, and another point which must not be lost sight of was that very often it was necessary to put up duplicate lines. In that case, too, the cheapest and most serviceable poles would be wooden and not of latticed steel.

Mr. E. Kilburn Scott hoped that the papers would be broadcast to the Dominions, because there they had the impression that they in this country did not know anything about overhead transmission lines. They were unaware that on Dartmoor and in parts of Scotland and Wales, and so on, the conditions were similar to those in the Dominions. There should be a change in the law, so that engineers could run lines where they wanted them and pay farmers one shilling a pole, whether it was a large or a small pole. The small farmers caused the trouble; the big landowners were not difficult to deal with, because transmission lines would bring business and population, and they would benefit thereby. Any particulars they could get into print with regard to 66,000-volt lines in this country would do them good abroad.

Mr. J. W. Wilkinson did not wish to say anything against latticed steel poles, though he did feel that there were positions where wooden poles would be advantageous, from the point of view of erection particularly, and there were certainly some positions, such as in boggy country, where one would expect them to stand up to the conditions better than steel.

Mr. W. J. Thomas said the author had remarked that it was hoped shortly to have a number of large "national bus-bars" throughout the country, and on that he had based his remarks as to bringing new transmission lines more or less into line with those abroad. He himself, however, could not see that they would be bus-bars so much as interlinking connections. Until they had some big tidal schemes generating stations would be steam-operated and located in the industrial centres, so that he could not see that they should ever have a line between stations longer than 50 or 60 miles, and they would not need the high voltages used abroad. He believed there was a rough rule that after, say, 10 or 20 miles, the economic voltage was about 1,000 volts per mile,

so that the maximum voltage they should be dealing with would be about 100,000 volts. In California a line carried on wooden poles had been working for many years at 110,000 volts. The chief things were safety and reliability; then came the economic question, and there would be fields for wooden, steel, and concrete poles. Rannoch Moor, he imagined, was just the place where steel poles would stand a chance. The base would cover a bigger area, and they need not concrete the whole foundation. It would only be necessary to put down brushwood sleepers, concrete round each leg, and carry the concrete up to a certain height above the ground level to protect the steel. Transmission lines would have to go near to quite a number of industrial centres, where all sorts of fumes were in the atmosphere, and the protection of the steel was a very important matter. With regard to one particular line with which he was connected there had been a tremendous lot of trouble with the conductors themselves and with the arms. The poles were of wood. With regard to steel-cored aluminium cables, he believed the chief trouble so far had been that they wanted to have long spans, and that again was a question of economics. In that connection wayleaves had been a cause of trouble.

Capt. A. C. SPARKS, dealing with Mr. Wilkinson's question as to the use of concrete poles, said the point was that the weight and handling difficulties were so great, as compared with other types, that their use was generally limited to routes along railways or roads. Further, as concrete was no good in tension, the amount of steel required for concrete-pole as against lattice-pole lines would be of the same order, taking into account that probably fewer poles would be required if the lattice-pole type were used.

Mr. C. H. RODDIS referred to a 40,000-volt line on steel towers in British Columbia which crossed land of a boggy nature. If they dumped a truck-load of metal on that land it would disappear in a day, and the difficulty was overcome by putting brushwood down and building a concrete pier, about 6 or 8 ft. above the ground, on which was erected the steel-lattice mast. Alongside there was a transmission line on wooden poles which had been in for about 10 years, and the only trouble they had had was due to trees falling across the line; there had been no trouble through the poles sinking.

Mr. J. W. WILKINSON asked whether any poles had been made with "Ciment Fondu." In his opinion it would be admirable for the foundations for steel supports on boggy land, where they required the cement to set very quickly. It was an aluminous cement, and was supposed to set reasonably hard in two hours, and piles could be driven after 48 hours.

Mr. J. H. COLYER, replying to the discussion, said that it was a foregone conclusion that all the towers were painted after erection; all joints were painted with bitumastic paint before assembly, and after the towers were erected they had two coatings of paint. On a line which had suspension type insulators he did not think bird guards were required, but on a steel-tower line carrying pin type insulators bird guards were very necessary in certain parts of the country. As to steel towers *versus* wooden poles, his firm was building what would ultimately be a single-circuit line, 36 miles long and operating at 66 kV, on wooden poles. In the paper, however, he had dealt with heavy trunk double-circuit lines, and he considered that owing to the spacing required they must have steel towers, bearing in mind also the length of the insulator. It had been his unfortunate lot a few years ago to have to make concrete poles on site, and to erect them in connection with a 20,000-volt line, and as a commercial proposition they were right out of court. The heavy costs of transport and erection were prohibitive. For local lighting work in a town where there were transport facilities and they could rig up a derrick on a lorry, or some other appliance such as that, it was a commercial proposition, because they could lift the poles right up and put them in the holes, but for double-circuit work he did not think they could be considered. The particular line to which he was referring had been up about six years, and was quite all right from an engineering point of view, but from a commercial point of view he hoped he would never have anything more to do with it.

With regard to long transmission lines in this country, at the present moment certain people were contemplating a line which would be 120 miles long and operate at 110,000 volts.

He had coined the term "national bus-bar" in order to give some indication of what he hoped would come about in the future. Galvanising increased the initial cost by about 10 per cent., on the cost of the tower, and it was money very well invested. There was nothing between porcelain and glass insulators, except that with glass a drawback was breakage; electrically, he believed, they were perfectly satisfactory.

The "Pathfinder" Tramway Guide.—The L.C.C is to install in the tramway shelter on the Victoria embankment, Westminster, a device for recording on a map the quickest route to any part of London from a given point. It consists of a kiosk with a central panel showing a map of the district to be served, and a number of push-buttons on either side. By pressing a button labelled with the name of the district to which it is proposed to proceed, the route is illuminated on the map.

Workmen's Compensation.

THE Home Office has just presented to Parliament the statistics of compensation and of proceedings under the Workmen's Compensation Act, 1906, and the Employers' Liability Act, 1880, for the year 1923. In 1923 the Workmen's Compensation Act materially changed the Act of 1906, but as it did not come into force until January 1st, 1924, no proceedings under that Act are included.

The statistics relate to compensation paid during 1923 under the Act of 1906 as varied by the Workmen's Compensation (War Addition) Acts, 1917 and 1919, and relate to the seven great groups of industries, namely, mines, quarries, railways, factories, docks, constructional work, and shipping. These groups embrace a large proportion of the chief industries, but they do not cover the whole field, and besides the various commercial, clerical and domestic employments to which the Act applies, important industries such as building, road transport and agriculture, are not included, no returns from employers being called for under Section 12 of the Act of 1906.

The average number of persons under the Act employed in the seven industries during 1923 was 7,342,311, a number slightly higher than in either 1921 or 1922, but over a million less than in 1919 and 1920, indicating a slight improvement in trade but not the complete recovery to the 7,509,353 of the last complete year before the war.

The total number of cases in which compensation was paid in 1923 was 480,035, a number almost equal to the highest (1913) for which returns have been made. It has been stated that compensation is less likely to be claimed when trade is good, which in effect means that compensation is in the view of some considered as an alternative form of unemployment pay and an examination of the returns appears to bear this out to some extent. It is of interest to note that while in 1923 the percentage of compensation cases to the total number employed was 6.5, the percentage in 1919, the year in which the greatest number was employed, was 4.4.

One happy feature about the returns is the gradual reduction in the number of fatal accidents. The number in 1923 was 2,657; this is higher than the minimum of 2,385 in 1921 but well below the 4,216 of 1914, or, excluding the years 1911 and 1914, in which there were large colliery explosions, the 3,748 of 1913.

The total amount of compensation paid was £7,134,096, of which £591,164 was in respect of fatal cases and £6,542,93[illegible] for non-fatal, showing an increase of 8.1 per cent. and 10 per cent. respectively on the cost for 1922.

In the Home Office Report for 1922 attention was drawn to the remarkable rise during the last few years in the number of cases and in the amount of compensation paid in the mining industry, the latter having risen from 29s. 6d. in 1919 to 62s. 9d. in 1923 per case, the figures for the docks and constructional work showing a similar rise.

In 1923 except in the case of shipping there was a rise in each of the industries in the ratio of cases to the number of persons employed, but this rise was confined to the non-fatal cases. With regard to factories and constructional work, the two of the seven industries with which the electrical industry is most closely associated, there was a small increase in the former, but the cases in constructional work were more than double those of 1919.

From a classification it would seem that the increase was almost entirely due to cases lasting less than 13 weeks, especially those less than four weeks, which constituted more than half the total number. The figures given for compensation paid represent the actual amount paid to workmen or their dependents. To this must be added administrative expenses, medical and legal costs, amounts placed to reserve and profits (which in the case of insurance companies constituted 48 per cent. of the total), but this large proportion was an improvement on the proportion for preceding years, which in 1921 was 64 per cent. and 55.5 per cent. in 1922.

A further improvement will be ensured by the arrangement made between the Home Office and the Accident Offices Associations for the purpose of limiting the charges to employers in respect of employers' liability insurance. By this arrangement it is provided that the total amount paid by the offices in the Association shall be not less than 60 per cent. of the premium in each of the years 1924 to 1926 with a further increase in subsequent years.

The cost of compensation per ton of coal raised was about 3.2d., which was somewhat similar to the cost in 1922 but higher than in 1919 and 1920, when the figures were 1.8d. and 2.4d. respectively.

A small proportion of the total number of cases (61 and [illegible]) were taken into Court and of these only 3,468 were original claims, the remainder being applications for dealing with allowances or settlements out of Court. Such a small proportion is a matter for satisfaction as it shows the ability with which compensation claims are dealt with and the confidence of the injured person that he is getting a "fair deal."

Very few cases are taken to appeal and applications to the Courts under the Employers' Liability Act, 1880, are steadily diminishing, only 33 being so dealt with in the whole of Great Britain, of which 27 were in connection with building and with factories and workshops.

The Report will be found of great interest and well worth perusal. It proves not only the necessity for the Compensation Acts, but is representative of the growing interest in social service which marks the politics and business life of to-day.

Reviews.

Population and the Social Problem. By J. SWINBURNE, F.R.S. Pp. 380. London: George Allen & Unwin, Ltd. Price 15s. net.

The earlier writers on economics were rather inclined to treat human beings as machines, actuated by an "enlightened self-interest," and the utilitarians, typified by John Stuart Mill, taught that the motive behind human actions was the pursuit of happiness. Their definitions of happiness appear inadequate and far from satisfactory to-day; and John Bright hit the mark pretty accurately when he observed that the worst of great thinkers is that they generally think wrong. Yet Bright himself held that the struggle of every individual to do the best for himself led naturally and inevitably to the best results for the community as a whole. This doctrine is expounded by Adam Smith; but it is not satisfactory to leave matters to develop in this anarchic fashion, and so it is found that to-day there are those who think that in order to avoid the evils that followed when men and things were left to themselves—such as child labour, women in coal mines, the building of vile slums, and so forth—it is necessary to control everything, and to nationalise all enterprise. There is common agreement upon the need for government, for the maintenance of order, and for the carrying out of the laws passed for the regulation of human conduct; but beyond this, agreement is less usual.

The stress due to the tendency of population to increase is called by Mr. Swinburne "population pressure"; and he imagines a condition in which population pressure is absent. "Suppose a plague had just carried off half the population of a large island, and the inhabitants abandoned their former habits and customs, and married and reared children at the physiological rate. There would be no population pressure for a short time." It seems as if this presupposes that every member of the population is equally efficient, and able to produce enough to sustain himself or herself. There is a definite pressure tending to reduce population, however small that population may be. To carry it to an extreme, one individual would find it very difficult to keep alive for long, even if he had all the world to work with. Mr. Swinburne has, of course, studied his Malthus, and his Adam Smith, and his Ricardo; and it is doubtful if he would have set out to write his book if he had not tried to find out what others had thought and written on the subject, or rather subjects, with which he intended to deal. In order to press home its points, he opens with a chapter called "De Cuniculis," in which he compares human beings with rabbits. "We are not amused," as Queen Victoria used to say, by this kind of parable, and we do not see what is gained by it.

We do not suppose anybody will be surprised to learn that the remedy led up to is birth control, which seems to us a negative sort of remedy. All will admit that if we could prevent the birth of persons who prove to be unfit, mentally or physically, it would be a very good thing, and the best way of dealing with the unfortunate beings themselves, if we may be pardoned for what seems rather like a "bull." But if we are to prevent unfit persons from being born, the race must be bred only from fit parents, and it would be necessary to *make* fit persons become parents. This means a society constituted on lines entirely different from any that have hitherto been developed—perhaps some sort of specialised community, worthy of that well-known writer who has written one book under scores of titles, Mr. H. G. Wel's.

There seems at least room for doubt as to whether a kind of painless race suicide will lead to human salvation.

The book is written in Mr. Swinburne's well-known style, which may perhaps be summed up as a semi-flippant manner of expounding matters of deep importance. It is astonishing how tiresome it becomes.—A.J.C.

Elements of Electrical Design. By A. STILL, Fel.A.I.E.E., M.I.E.E. Pp. xxi+535; figs. 191. London: McGraw-Hill Publishing Co. Price 25s. net.

Prof. Alfred Still, of Purdue University, U.S.A., is the author of several volumes on electrical engineering, such as "Electric Power Transmission," "Principles of Transformer Design," and "Principles of Electrical Design," and the one now under review will enhance his reputation as a writer on electrical machine design. Though American books are certainly more acceptable to English readers than German and French textbooks, American names and units are, nevertheless, often confusing to us. Gilberts, maxwells, oersteds, circular mils, B. & S. gauge, &c., are not sufficiently familiar to people in this country to make the application of formulæ a simple matter. As for units, whatever may be in store for the designer of the future, the designer of the present has but one prayer—that the writer will stick to *one* system. We are aware that this is asking for much, but surely if we are prepared to be contented with either English or C.G.S. units, the author might accede to this request instead of employing both systems in the same book.

Let us now examine the contents. We may say at once that these are good, and they are presented in an attractive form. Needless to say, there are many points with which we do not agree, but it would be pusillanimous to let these bias our judgment.

Coming now to the chapters, the student at once is brought into touch with practical problems. Under the electric circuit, the design of open-coil wire, grid and submerged wire resistances, and the calculation of magnet coils are treated. The chapter on the magnetic circuit is followed by one on the design of electromagnets, in which the short-stroke and plunger types, and the magnetic circuit of the dynamo are discussed. The dielectric circuit, with calculations on condensers, creepage distance, cables, insulation, and the like, is then dealt with.

The preliminary ground having now been covered, the reader comes to the chapters on electromagnetic machinery. Some of the sections here are not treated as fully as the earlier sections. Thus, commutator windings are dismissed rather summarily, the reader being recommended to search elsewhere for further information. In the footnote of p. 188, the word "multiple" has obviously been used instead of "multiplex." A praiseworthy attempt is made to outline the design of d.c. generators, synchronous generators, polyphase induction motors, and transformers, while the book closes with a chapter on mechanical design. Much useful information is contained in these chapters, and the student will receive much aid from the worked-out examples. In addition, a large number of test problems with answers are added. The book can be strongly recommended.

Practical Radio. By JAMES A. MOYER, S.B., A.M., and JOHN F. WOSTREL. Pp. viii+249; figs. 169. London: McGraw Hill Book Co., Inc. Price 8s. 9d. net.

Mr. Moyer is the Director of University Extension, Massachusetts Department of Education, and Mr. Wostrel is Instructor in Radio to that Department.

The object of the book is "to present the fundamentals of the subject so simply and clearly that any person of average training will be able to read, understand, and apply them," and, in addition, the practical information given includes working drawings for the construction of a number of typical receiving sets.

The fact that this book is of American origin in no way detracts from its value to British readers, as, apart from some information on various patterns of valves and on Government regulations, there is nothing in it which does not apply as well to British as to American practice. In fact, there is much in the book which should be of great interest to British amateur experimenters, especially the details of what might be called long-range receivers, as in this branch of radio technique the American amateur is, as a rule, ahead of his British *confrère*.

The terms used throughout are identical with those used on this side, with a few exceptions which are already quite familiar to our amateurs.

The information given is right up to date; in fact, few would have ventured to write even a month or two ago as on page 235, "that daylight has but little effect on the carrying power of short waves," a statement which even now, however, requires considerable qualification.

No mathematical or electrical knowledge is required by the reader, and the book can be recommended as a good text book for the serious amateur experimenter or as a good introduction for the student who is preparing to make a more extensive study of the subject.

Recent Progress in Engineering Production. By C. M. LINLEY, Consulting Engineer. Pp. 340; figs. 303. London: Ernest Benn, Ltd. Price 42s. net.

This book has been written with the object of giving engineers and manufacturers of machinery information regarding the latest type of machine tools, particulars of works practice, manufacturing methods, processes, and alloys. The improvements described are mainly those which tend to reduce the cost of production, and at the same time should enable the manufacturer to produce a better and more saleable article than is possible by the older methods.

The author is a practical engineer not connected in any way with the manufacturers of the machines described, and in nearly all cases where specific machines or apparatus are described and recommended information has been included which will enable the reader to get into touch with the manufacturers or agents who can supply the particular article.

Chapter I of the book deals with grinding, and it is pointed out that the grinding of cylindrical work in many cases is more economical than fine turning. Many new and improved types of grinding machines have quite recently been introduced and they are fast becoming machine tools in the true sense of the word, working from the rough castings or forgings.

Several new surface and face grinders are described and illustrated, all of which contain novel features, and the Churchill turret universal grinder is shown.

The chapter devoted to the subject of metal cutting is of special importance, as considerable development in this direction seems likely to take place in the near future. Methods of cutting bar metal are discussed, and a number of machines described.

The difficulties met with when splining motor gear-box shafts, particularly when they are long and slender, are met

to a great extent by the hobbing machines illustrated in Chapter IV.

A long chapter is devoted to modern methods of producing ball bearings, and the whole process is carefully described.

Suitable methods for localising hardening and case-hardening are referred to, and the importance of obtaining the correct quality of steel for a given purpose is emphasised, this having a very important bearing on output. Optical and thermo-couple pyrometers, together with particulars of heat measuring and recording instruments occupy a chapter. Gear generating, gear cutting, and gear grinding machines are considered, and the machines illustrated and described are undoubtedly in the front rank of this particular class of machine.

A chapter is devoted to the criticism of existing machine tools. Defects in milling machine construction are noted, and these are generally recognised. The suggested improvements relate chiefly to the width of the knee and vertical slide, and to the design of the overhead arm brace. A number of improvements are also suggested for the centre lathe and the planing machine. In the latter case the problem of making a planing machine cut in both directions of the table movement is referred to, and it is suggested that this problem does not differ so widely from other problems that the engineer has to admit complete defeat.

It is impossible to refer to all the subjects dealt with in the book, because practically every branch of engineering workshop practice is considered in the light of the most recent practice.

The manufacturer and practical engineer will find the book to be an encyclopædia of modern practice of material importance and assistance, and no technical library can be considered complete without a copy. The production is a credit to the author and the publisher.

E.P.

Michael Faraday. By WILFRED L. RANDELL. Pp. 192. London: Leonard Parsons, Ltd., 1924. Price 4s. 6d. net.

This is a charming story of the life of a man great in his science and great in his simplicity. To all who have played a large part in the drama of life is given the opportunity of living in the memory of posterity, and in the long list of men of science to whom this honour is due, few are entitled to a higher place than Faraday. The author has revealed Faraday as he was to all who knew him, a man of true genius, unfailing modesty and boundless enthusiasm entirely unspoiled by success. Somehow the work of pioneers in science is always associated in one's mind with lectures before learned societies; here we have an account of a life spent in real pioneering work, a wonderful record of the discovery, testing and acceptance of theories which are now accepted as commonplaces of fact. Faraday's career was one of discovery, unparalleled in the history of experimental science, and his speculations and experiments on the possible action of the earth when water, whether tidal or fluvial, flowed over its surface, are deeply interesting. The following avowal and prediction made in 1831 breathe the very spirit of the true investigator: "I have rather been desirous of discovering new facts and new relations dependent on magneto-electric induction, than of exalting the force of those already obtained, being assured that the latter would find their full development hereafter." The electric lighting of the present day is surely a splendid fulfilment of this prediction.

Faraday's experiments and speculations on the deportment of crystals in the magnetic field, a deportment predicted by Poisson and discovered experimentally by the illustrious geometrician Plücker, are profoundly interesting and instructive; they throw more light than any others on Faraday's mind and culture, and almost grim independence of character. His influence as a lecturer at the Royal Institution consisted less in the logical and lucid arrangement of his material, than in the grace, earnestness and refinement of his whole demeanour, astounding fertility of ideas and remarkable experimental skill; he possessed a rare power of eliminating unessentials.

The ground covered by the experimental researches of Faraday is astonishing in its extent; the principles and reactions which Faraday discovered, examined and proved, are fundamental. They are the corner stone of the vast electrical industry, and the basis of the immensely elaborate electrical generating machinery of to-day. They have been developed and applied to lighting, power, and traction, and they are the principles upon which wireless telegraphy is founded.

The closing words of this book may fittingly be quoted. "In electrical matters we can be sure that Faraday's influence will never be lost, however many great discoveries may intervene; his secure position as pioneer none can ever dispute."

Motor-car Electric Lighting Standards.—The Institution of Automobile Engineers has just issued data sheets, Nos. 114, 115, 116, and 117, showing the provisional standards adopted by the Society of Motor Manufacturers and Traders for the dimensions of dynamos with saddle or flange mountings (3 sheets), distributor mountings, starting-motor flange mountings (2 sheets), and dynamotor dimensions.

Published Specifications.

Compiled expressly for this journal by Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1923.

17,520. "Variable electric resistances and control switches therefor, especially applicable to electric motor switchgear." F. B. Cox. July 6th, 1923. (227,135.)

17,976. "Means for generating electric oscillations of high frequency." C. S. Franklin. July 11th, 1923. (227,138.)

22,164. "Radio-receiving apparatus." Johnson-Williamson Laboratories, Inc. September 25th, 1922. (204,315.)

22,477. "Method of telautographic transmission of handwriting and drawings by perforated strips on type-telegrams." A. Kohn. September 6th, 1923. (227,150.)

24,810. "Electromagnetic transmitters and receivers for reproducing sound." A. F. Sykes. October 5th, 1923 (Cognate applications 10,004/24 and 10,687/24.) (Addition to 160,223.) (227,162.)

24,991. "Apparatus for converting sound waves into variations of electric current." T. W. Case. October 8th, 1923. (227,173.)

24,998. "Electrical signalling systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). October 8th, 1923. (227,175.)

25,084. "Electrical switches and switch fuses." Midland Electric Manufacturing Co., Ltd., and W. L. Barber. October 9th, 1923. (227,181.)

25,124. "Electrical heating apparatus." F. V. Hadley and R. A. Carleton. October 9th, 1923. (227,184.)

25,143. "Electric sub-stations." Metropolitan-Vickers Electrical Co., Ltd. May 19th, 1923. (216,085.)

25,241. "Receiving sets for wireless signalling." J. M. Turner and L. H. Soundy. October 10th, 1923. (Cognate applications 29,587/23 and 14,742/24.) (227,189.)

25,286. "Electric vehicles." Tilling-Stevens Motors, Ltd., and H. E. Whitehorn. October 10th, 1923. (227,195.)

25,476. "Electrolytic rectifiers." M. A. Codd. October 12th, 1923. (227,203.)

26,177. "Cabinets for wireless apparatus." C. W. Hayward and A. J. Stevens & Co. (1914), Ltd. October 20th, 1923. (227,222.)

26,432. "Electric furnaces." L. J. Hancock and T. R. Hancock. October 23rd, 1923. (227,223.)

26,619. "Thermionic valves." H. Wade (Mills Novelty Co.). October 24th, 1923. (227,224.)

27,882. "Gramophones, loud speakers, and other sound-recording or reproducing apparatus." C. M. De C. De la Bourdonnais. November 6th, 1923. (227,240.)

29,934. "Electric lamp holders." F. Barraclough. November 28th, 1923. (227,254.)

31,120. "Mercury-vapour lamps." Hewittic Electric Co., Ltd. (Westinghouse Cooper Hewitt Ges.). December 11th, 1923. (227,263.)

31,463. "Magneto mounting for internal-combustion engines." Normand Garage, Ltd., and H. D. Smith. December 14th, 1923. (227,267.)

31,858. "Variable electric condenser or capacity." D. V. L. Fellows, L. V. Clark and A. R. Pike. December 19th, 1923. (227,273.)

32,365. "Device for the interruption and the control of a discharge tube containing rarefied gas or vapour, fed by an alternating-current source." L. D. J. A. Dunover, P. M. G. Toulon, and Soc. de Recherches et de Perfectionnements Industriels. December 23rd, 1922. (209,096.)

1924.

782. "Rotary electric contact device." C. Lorenz Akt. Ges. May 8th, 1923. (215,715.)

1,698. "Dry cells." Manhattan Electrical Supply Co., Inc. July 30th, 1923. (219,924.)

3,289. "Inductance or tuning coils." I. H. Parsons and A. E. J. Ball. January 29th, 1924. (Cognate application, 22,907/24.) (227,288.)

4,682. "Diaphragms for sound-reproducing or recording apparatus." G. H. Crosby and C. J. Adams. February 23rd, 1924. (Cognate application 5,773/24.) (227,303.)

4,768. "Electric lighters for cigars and the like." A. Schoeller. February 25th, 1924. (227,304.)

5,177. "Small electric motor serving to drive low-speed mechanism." Landis & Gyr Akt. Ges. March 1st, 1923. (212,264.)

6,617. "Cores for inductance coils." K. Von Wysiecki. August 1st, 1923. (219,931.)

8,091. "Electrolytic process for preparing iron-oxide pigments." H. G. C. Fairweather (Magnetic Pigment Co.). March 31st, 1924. (227,319.)

8,337. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). April 2nd, 1924. (227,320.)

8,617. "Telephone systems." Coventry Automatic Telephones, Ltd., and J. E. Collyer. April 5th, 1924. (227,322.)

9,440. "Connections between conductors of electric cables." Felten and Guilleaume Carlswerk Akt. Ges. April 20th, 1923. (214,620.)

9,693. "Switching systems for electric transmission circuits." Metropolitan-Vickers Electrical Co., Ltd. April 21st, 1923. (214,635.)

11,007. "Adjustable liquid electric resistances." C. A. A. Haighton. May 5th, 1924. (227,339.)

12,816. "Electrical protective relay." Metropolitan-Vickers Electrical Co., Ltd. May 26th, 1923. (216,531.)

12,928. "Lighting systems for mine trains." E. Adams and A. H. McAnulty. May 26th, 1924. (227,348.)

13,127. "Electric switchgear for outdoor transformers and transmission lines." E. Johnson. May 28th, 1924. (227,350.)

13,427. "Electric discharge tubes having an incandescent cathode, an anode, and one or more grid-electrodes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. June 2nd, 1923. (216,896.)

14,438. "Electric-arc transformers." E. Schroder. June 14th, 1924. (227,360.)

15,535. "Receiving systems for wireless signals." Rodo Patents, Ltd., and F. A. L. Sloot. June 27th, 1924. (227,364.)

16,202. "Bogies for railway and tramway vehicles." Waggon und Maschinenbau Akt. Ges. Gorlitz. July 20th, 1923. (219,300.)

16,628. "Electric vehicles." Tilling-Stevens Motors, Ltd., and H. E. Whitehorn. October 10th, 1923. (Divided application on 227,195.) (227,367.)

18,880. "Radio-transmission systems." Western Electric Co., Ltd. October 18th, 1923. (223,537.)

18,983. "Spiral filaments for electric incandescent lamps." General Electric Co., Ltd. February 14th, 1924. (227,385.)

20,267. "Motor-suspension systems for electric locomotives and other electrically-propelled vehicles." Metropolitan-Vickers Electrical Co., Ltd. September 22nd, 1923. (222,098.)

21,128. "Electric pocket lamp and battery arrangement." Dr. W. Friedrich. September 8th, 1923. (221,517.)

21,689. "Electric apparatus for the reproduction of recorded sounds." A. F. Sykes. July 3rd, 1923. (Addition to 160,223.) (Divided application on 222,924.) (227,391.)

23,054. "Anode batteries." R. Sachs. September 30th, 1924. (Addition to 226,136.) (227,396.)

23,813. "Electric couplings for measuring instruments for use with fuse-boards." E. Bardenbacher. December 1st, 1923. (225,582.)